DEPARTMENT OF MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1975/72

CRUSTAL STRUCTURE UNDER THE MOUNT LAMINGTON REGION OF PAPUA NEW GUINEA.

By

D.M. FINLAYSON, B.J. DRUMMOND, C.D.N. COLLINS AND J.B. CONNELLY

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Abstract

The Mount Lamington strato-volcano in eastern Papua is underlain by the ophiolite suite of rocks which make up the Papuan Ultramafic Belt and is situated near a north-south magnetic anomaly offset which marks the western limit of current volcanic activity on the Papuan peninsula. The Moho in the region shallows from depths of about 21 km under the northeast Papuan coast to 8 km under Mount Lamington. The crustal layers are interpreted as having P-wave velocities of 2.8, 3.7, 5.66 and 6.86 km/s which are similar to those found for oceanic layers 1, 2 and 3. However, the total crustal thickness along the coast is about twice that of normal oceanic crust.

The crustal layers dip towards the Solomon Sea at angles between 13° and 19°, which are higher than the 9° dip determined from magnetic models but much less than the $25^{\circ} - 60^{\circ}$ dips used in previous gravity modelling. The Moho depth along the southwest Papuan coast is about 26 km, decreasing towards the Coral Sea. There is evidence for a low-velocity zone under the Mount Lamington region at depths between 35 and 50 km.

Deeper lithospheric processes are responsible for the calc-alkaline volcanism of Mount Lamington and may be related to the minor earthquake activity at shallow and intermediate depth, possibly associated with a fossil Benioff zone.

INTRODUCTION

Mount Lamington (1585 m) is one of a number of large Quaternary strato-volcanoes which lie northeast of the Owen Stanley Range in eastern Papua (Fig. 1). Until 1951 it had been regarded as dormant because there was no history or legend of activity, but in January of that year a catastrophic Pelean type eruption occurred which caused considerable loss of life and property damage (Taylor, 1958). A seismic monitoring system was subsequently set up on the northern slopes of the mountain to detect earth tremors. Data are telemetered to a recording station in Popondetta for immediate inspection.

In 1973, the Mount Lamington station was one of the recording stations operating during the East Papua Crustal Survey, a regional seismic survey designed to investigate some of the major structural features of the Papuan peninsula (Finlayson, in prep). Preliminary interpretations of crustal structure in the Mount Lamington region have been derived from data recorded at stations in that region. These interpretations, together with those of aeromagnetic work (CGG, 1969, 1971, 1973), enable basic structures under Mount Lamington to be outlined.

REGIONAL GEOLOGY

The geology and structure of eastern Papua (Fig. 1) have been discussed by Davies (1971), Davies & Smith (1971), Milsom (1973) and St John (1970). The Mount Lamington volcanic region lies on the Solomon Sea side of the Papuan Ultramafic Belt. This Belt is an ophiolite suite of rocks regarded as the surface exposure of a dipping slab of Jurassic oceanic crust and mantle, which has been obducted onto sialic crust during an episode of crustal convergence in the late Eocene (Davies, 1971; Dewey & Bird, 1970; Coleman, 1971; Moores, 1973). During this episode, the Owen Stanley Metamorphics were formed from Cretaceous sediments deposited at the northeastern margin of continental Australia and rifted from Australia during the opening of the Coral Sea prior to separation of

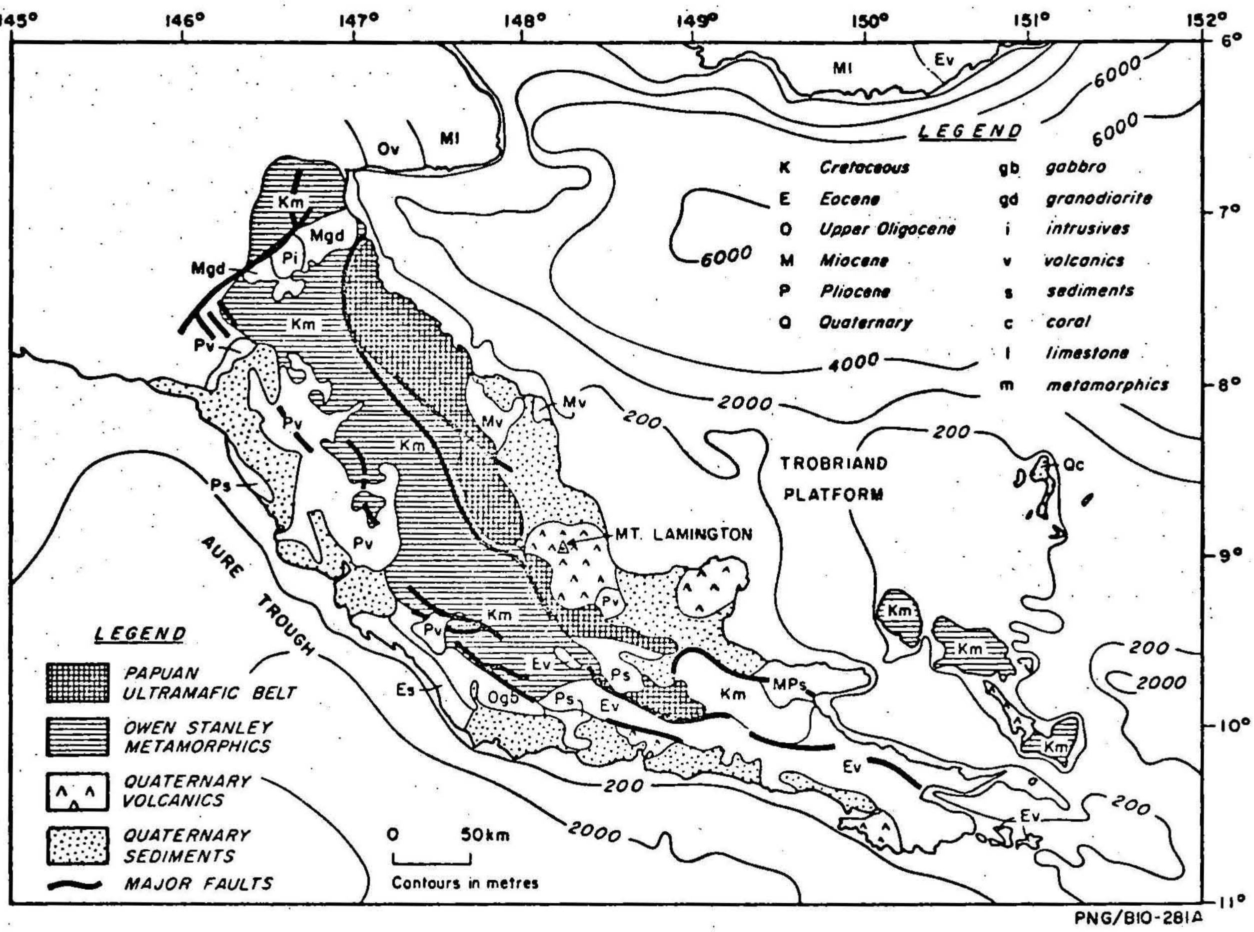

Fig.1 Simplified geological map of eastern Papua.

Australia from Antarctica in the early Eocene. The metamorphics now form the mountainous spine of the Papuan peninsula. Milsom (op. cit.) has discussed the various proposed methods of emplacement of the ophiolite suite and concluded that there is a possibility that it may represent crust of a marginal basin type rather than a true oceanic type.

After emplacement of the Papuan Ultramafic Belt, volcanism took place in the late Miocene and Pliocene on the Papuan peninsula and offshore islands and continued through the Quaternary to the present time (Johnson et al., 1973; Smith, 1973, Taylor, 1958). It is difficult to relate the present episode of volcanism to the Tertiary tectonic episode which resulted in the emplacement of the ophiolite rocks. However, Mount Lamington and the other active volcanoes lie on the northeast margin of the Indian-Australian lithospheric plate where it abuts against a series of contrasting crustal types in a region of crustal convergance between the Indian-Australian and Pacific plates. The tectonic development of this northeast margin has continued since the separation of Australia from Antarctica in an episodic manner.

This development is illustrated in recent times by the pattern of earthquake activity (Denham, 1969) and volcanic activity (Johnson et al., 1973; Johnson et al., 1970) in the region. The shallow and intermediate seismicity of the Papuan peninsula is minor compared with the major earthquake zones to the north and east but it is significant, and some form of left-lateral strike-slip movement in the general direction of the Owen Stanley Fault is essential to the tectonic synthesis of the Papua New Guinea region as a whole (Johnson & Molnar, 1972; Krause, 1973; Luyendyk et al., 1973; Milsom, 1970). Ripper (in prep.) has computed focal mechanism solutions for two earthquakes off the tip of the Papuan peninsula, one of which indicates strike slip movement parallel to the geological strike and the other rifting.

SURVEY OPERATIONS AND DATA

The operational details of the East Papua Crustal Survey have been described by Finlayson (in prep.). Briefly, 111 shots were fired at sea (5 were small test shots) and 42 recording stations were positioned as shown in Figure 2. The stations were operated by the following institutions; Bureau of Mineral Resources (24), Australian National University (9), University of Queensland (3), Warrnambool Institute of Advanced Education and Preston Institute of Technology (3), PNG Geological Survey (3) and the University of Hawaii (1). The shots were usually either 1 tonne or 180 kg and were fired at approximately 100 m depth; a water replacement velocity of 4.0 km/s was used for shot point corrections. Most of the recording stations were equipped with high-gain, slow-speed, automatic tape recorders but the permanent stations in the region (denoted by a 3 letter mnemonic in Fig. 2) were equipped with either photographic or smoked paper drum recorders. Mount Lamington station (LMG) was of the latter type and was successful in recording 101 of the 111 shots, a performance bettered by only one other station (Mount Lawes, ML).

The regional gravity coverage of the Papuan peninsula was also completed during the 1973 survey period by helicopter, and this enabled a composite picture of the gravity field to be compiled using the BMR preliminary marine data (Tilbury, in prep.) and the land stations. Milsom (1973) has interpreted the regional gravity data straddling the Ultramafic Belt and constructed models to fit the observed values. The general gravity trends are consistent with the geological synthesis for the area but the gravity models require a thicker crustal section. Much of the detail in the gravity models must be regarded as speculative at the survey station spacing used.

As described later in this paper, high level aeromagnetic

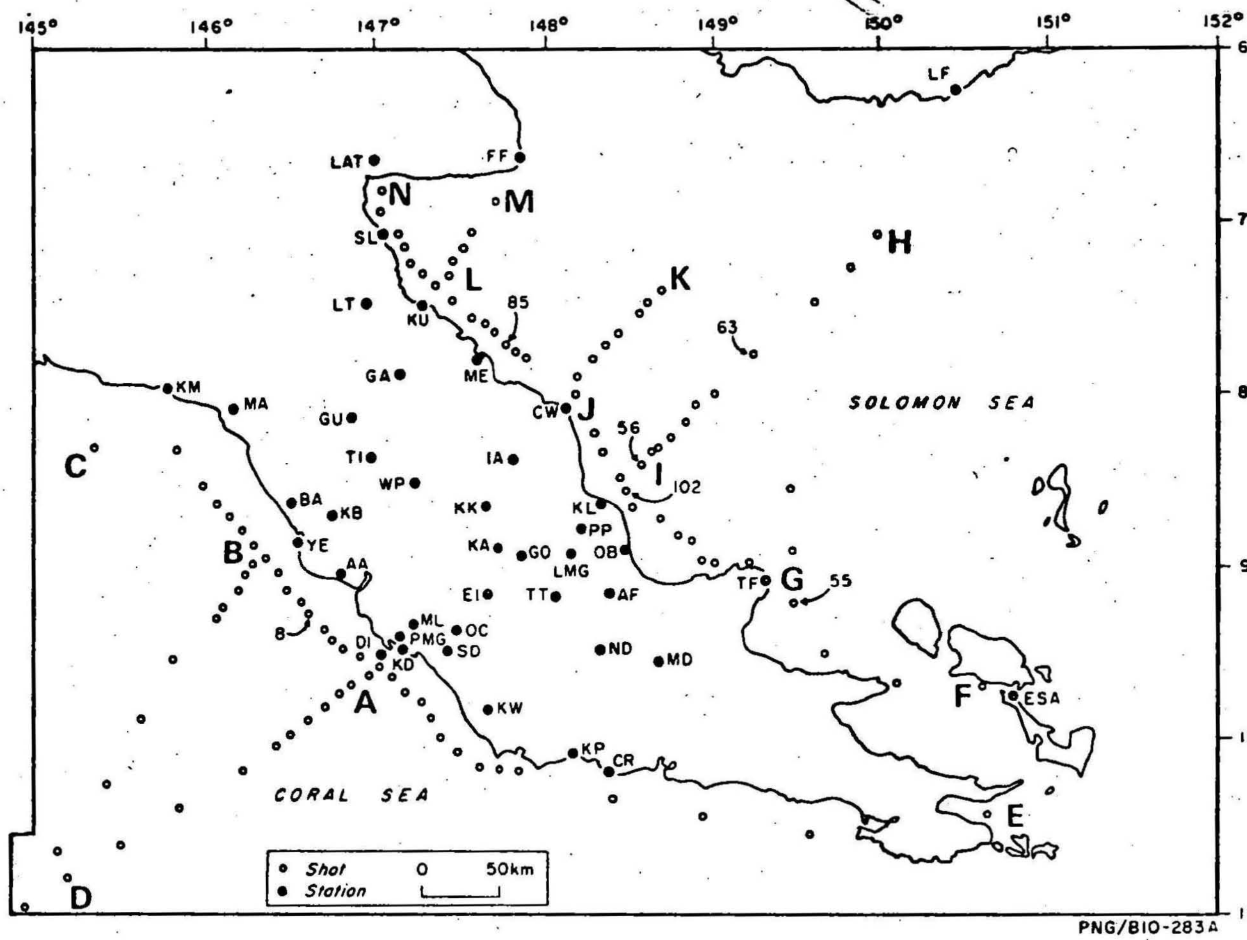

Fig.2 East Papua Crustal Survey 1973, shot and recording station locations.

coverage of the Gulf of Papua, Papuan peninsula and Trobriand Platform has also been completed (CGG, 1969, 1971, 1973) enabling depths to magnetic basement to be determined in these areas and some of the tectonic provinces to be delineated.

CRUSTAL STRUCTURE SOUTHWEST OF MOUNT LAMINGTON

Shots along line CBAE (Fig. 2) were recorded at several stations along the southwestern coast of the Papuan peninsula, giving approximately reversed profiles between Yule Island (YE) and Cape Rodney (CR). Unfortunately it was not possible to reverse the two lines of shots into the Coral Sea (lines AD and BD).

Representative time-distance plots from two groups of stations along the south coast are shown in Figure 3. Yule Island (YE), Kubuna (KB) and Aroa (AA) are grouped together, as are Cape Rodney (CR), Kupiano (KP) and Kwikila (KW). Also shown in Figure 3 is a time-distance plot of data from shots along line AD recorded at Daugo Island (DI). All travel-time data plots presented in this paper have been reduced by the shot-station distance divided by 8.0 which highlights changes in the apparent velocities near 8.0 km/s (parallel to the horizontal axis).

The data from the stations in Figure 3 and also from Mount Lawes (ML) were used to derive a simple three-layer crustal model along the southwest coast (Fig. 4). The uppermost layer has been assigned a velocity of 4.0 km/s. Survey design did not enable the recording of energy from this layer as first arrivals although it is sometimes present as later arrivals, as in Figure 3, where a refractor of 4.78 km/s is evident. Using 4.0 km/s as an average velocity, the uppermost layer appears to have an almost uniform thickness of 6-7 km along the southeast half of line CBAE, but thickens to approximately 10 km in the northwest. This coincides with the sediment distribution in the Aure Trough indicated by Mutter (1975) and CGG (1969).

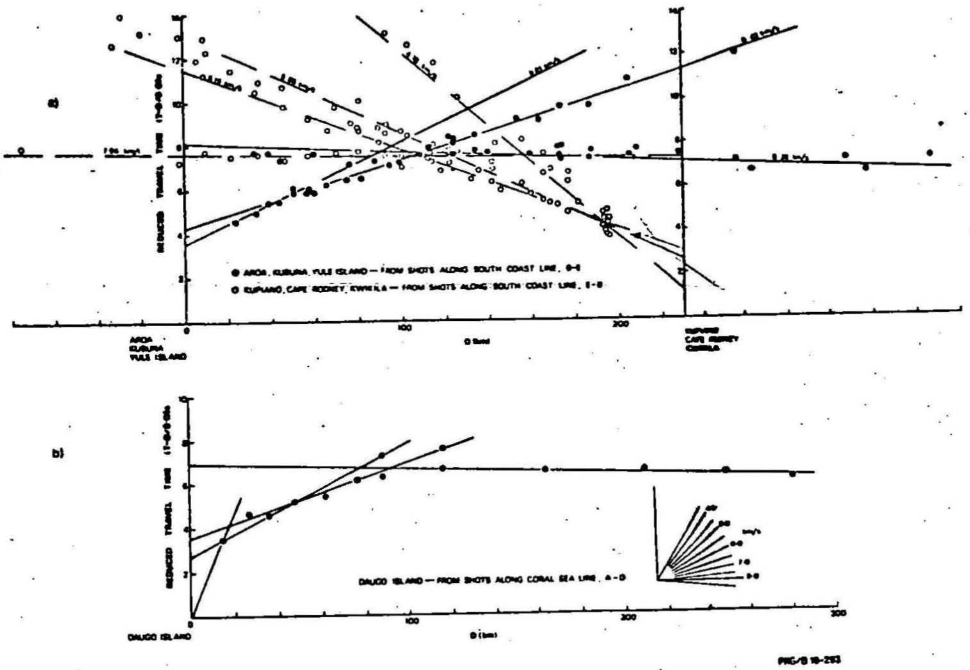

Fig.3 Seismic travel-time plots (reduced by shot-station distance/8.0) for stations along the southwest Papuan peninsula coast from (a) shots along the coast, and (b) shots out in the Coral Sea.

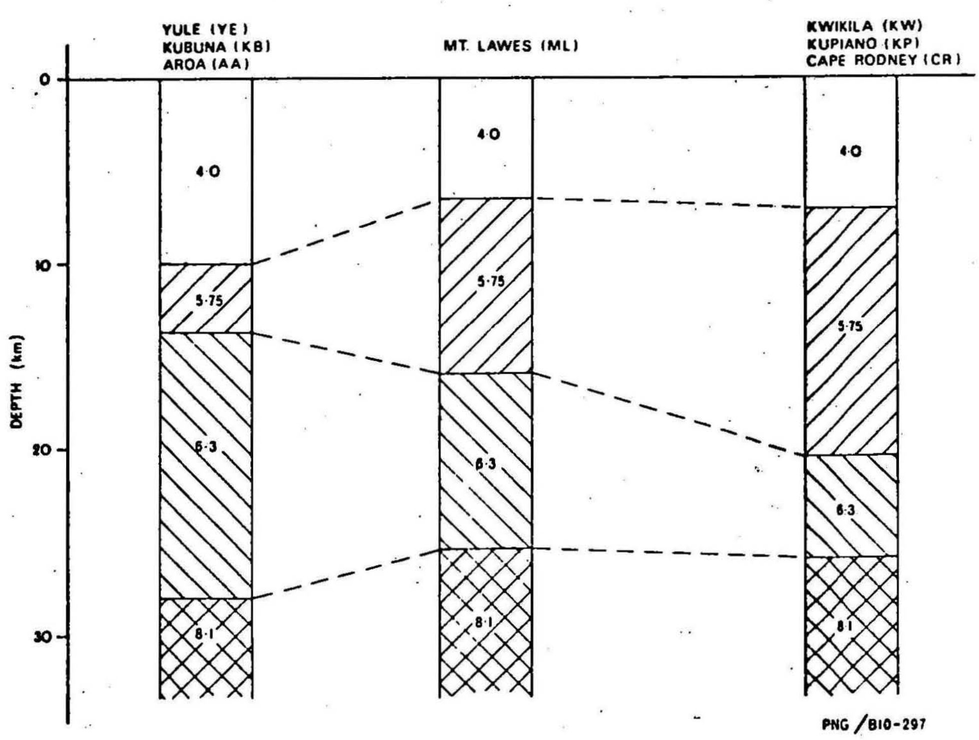

Fig.4 Simplified crustal structure along the southwest Papuan peninsula coast.

Profiles both along the coast and in the Coral Sea indicate that velocities for the deeper crustal layers lie within the ranges 5.6–5.85 km/s and 6.0–6.45 km/s. Compilation of composite seismic record sections is necessary to define these velocities accurately because energy from the deeper layers commonly occurs as later arrivals. The velocities of 5.75 km/s and 6.3 km/s indicated in Figure 3 are considered representative of these refractors. From north to south the 5.75 km/s layer appears to thicken and the 6.3 km/s layer thins.

Crustal information from the Coral Sea lines is available only near the coast, so it is necessary to interpret the Coral Sea structure by extrapolation using the data along the single ended refraction lines AD and BD. An increase in the delay times of shots within 100 km of the coast implies an increase in the sediment thickness in the Aure Trough and its southeastern extension. The data are in good agreement with the model proposed by Mutter (op. cit.) on the basis of gravity data, in which the sediments increase in thickness to about 7 km within the Trough. This model requires the mantle depth to decrease by about 6 km beneath the thickest part of the sedimentary pile to achieve isostatic equilibrium.

A mantle velocity of 8.1 km/s is found along the southwest coast, giving Moho depths under Cape Rodney (CR) and Mount Lawes (ML) of 25–26 km. The Moho dips to about 28 km below the northern coastal stations. An apparent Moho velocity of 8.2 km/s from shooting lines out into the Coral Sea suggests that the crust thins from the southwest Papuan peninsula coast towards the Coral Sea.

The crustal structure illustrated in Figure 4 is derived from simple plane layered models, but it is recognised that a more complex velocity-depth relation is likely and this is being investigated.

SEISMIC TRAVEL-TIME FEATURES THROUGH THE MOUNT LAMINGTON REGION

Two sets of shot and station data have been selected to illustrate the dominant features of seismic travel-times traversing the Mount Lamington region.

The first is illustrated by a seismic travel-time plot of recordings made at all stations from shots 56 and 8 on the northeast and southwest coasts of the Papuan peninsula respectively (Fig. 5).

The most pronounced feature of the plot is the asymmetry of the travel-times from the two shots. The arrivals from shot 8 on the southwest coast to all stations along azimuths ranging over 180° indicate successive increases in apparent velocity as distance from the shot-point is increased. The departure of some travel-times from the approximately fitted lines only slightly detracts from the overall trend and many of the departures are readily explained.

The travel-time plot of data recorded from shot 56 on the northeast coast, however, exhibits entirely different characteristics. Over an azimuth range of 180°, a high apparent velocity (8 km/s) is evident from distances less than 50 km out to distances of over 200 km. The departures from the approximately fitted line are small. The stations that indicate this high velocity at an intercept of approximately 4.5 s are all located northeast of the Owen Stanley Fault. The same stations that recorded shot 8 from the southwest coast indicate similar apparent velocities, but with intercepts greater than 8.0 s, demonstrating that a considerably longer ray path is required in traversing the peninsula from southwest to northeast.

A longer travel-time is also evident in the data from shot 56 recorded at stations southwest of the Owen Stanley Fault. It is not until the shooting distance is about 180 km, however, that the travel-times from the two shots are similar. The asymmetry is undoubtedly due to greatly differing crustal structure on the northeast and southwest coasts of the Papuan peninsula. A simplified interpretation of crustal structure for

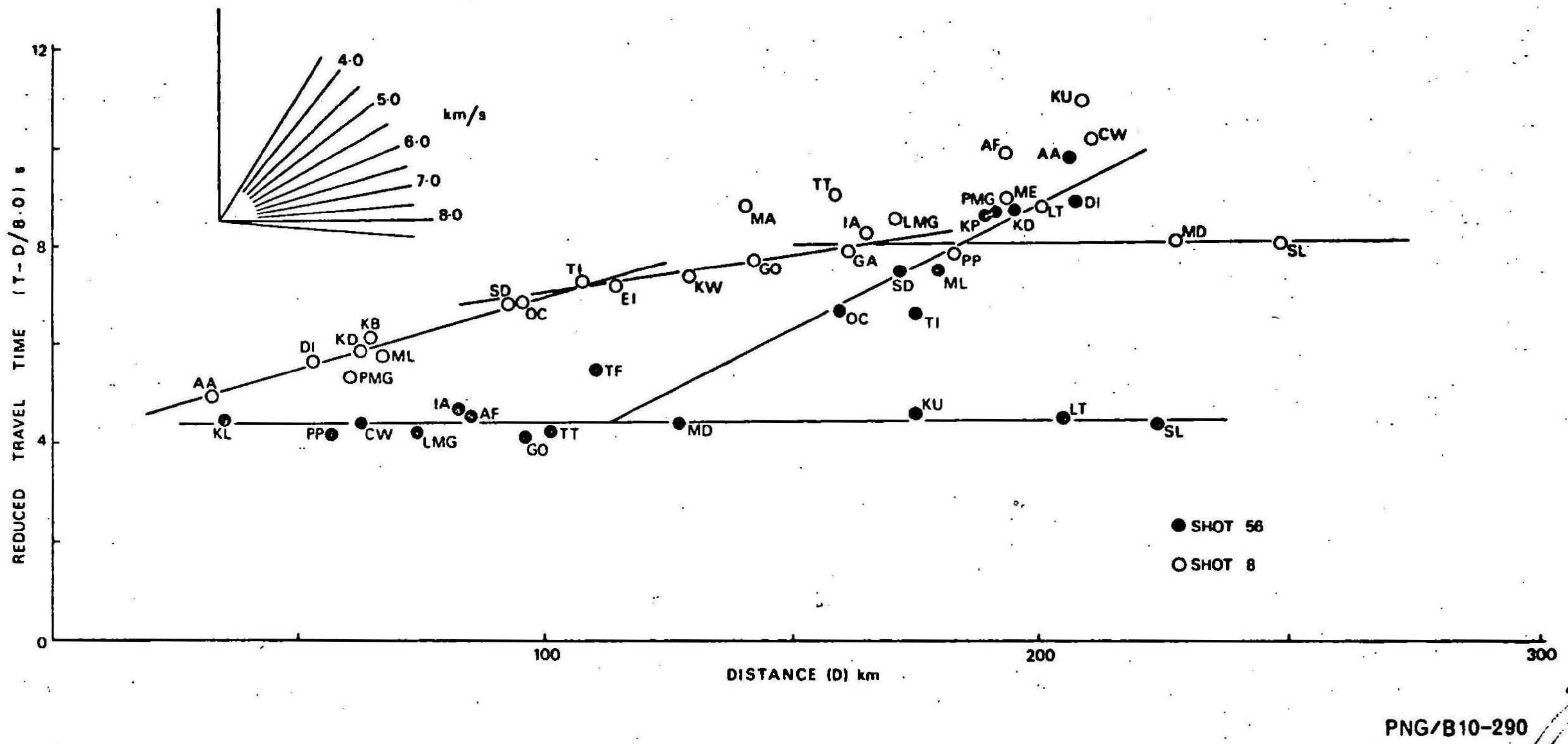

Fig.5 Reduced seismic travel-times to all recording stations from shots 8 and 56.

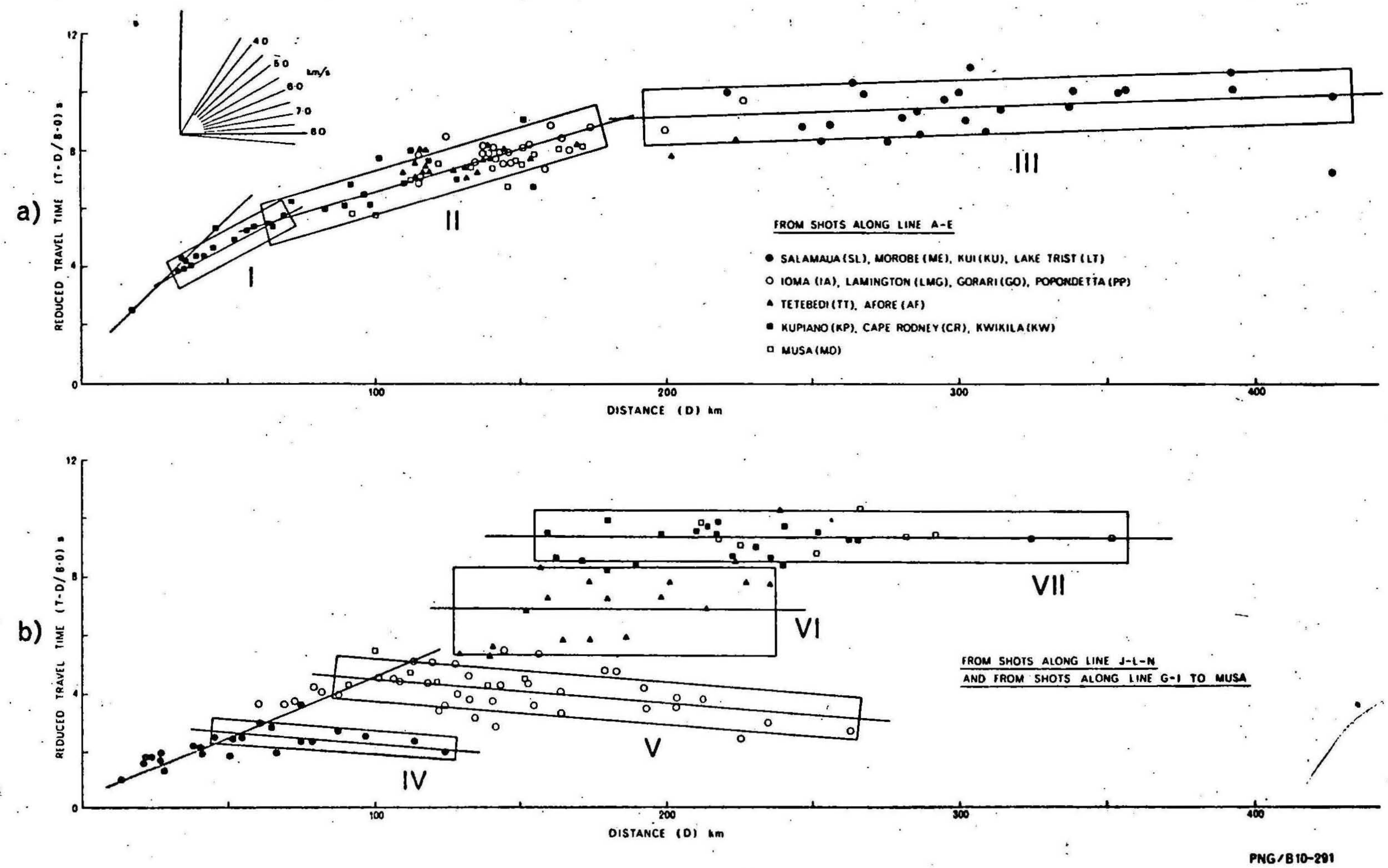

Fig.6 Reduced seismic travel-times from shots along (a) shooting line J-L-N, and (b) shooting line A-E.

the southwest coast and Coral Sea is presented earlier in this paper and an interpretation along the northeast coast is presented by Finlayson et al (in prep.) and is summarized here.

There are distinct differences in the crustal structure between the areas where the Papuan Ultramafic Belt crops out along the northeast coast and the region of the Trobriand Platform. Between Salamaua (SL) and Morobe (ME), surface layer P wave velocities of 4.4 km/s are recorded and a prominent refractor with a velocity of 6.98 km/s is interpreted at depths between 2.5 and 6.0 km. The Moho is interpreted at 20 km depth with an upper mantle velocity of 7.96 km/s. Between Morobe (ME) and Tufi (TF) across the Trobriand Platform, upper crustal layers with velocities of 2.8, 3.7 and 5.66 km/s and total thickness between 10 and 15 km are interpreted, overlying lower crustal material with velocity 6.86 km/s. The Moho is interpreted as lying at depths between 20 and 23 km and the upper mantle velocity is 7.96 km/s. Computer modelling along the northeast coast indicates the existence of a low-velocity zone at depths between 35 and 50 km.

The second set of data is illustrated in Figures 6(a) and (b) which shows two travel-time plots, one from shots along traverse A-E (Fig. 2) and the other from shots along traverse J-L-N (and traverse G-I to Musa), with common recording stations along the zone between the sets of shots. The time-distance plot in Figure 6(a) displays similar characteristics to that in Figure 5 from shot 8. The envelopes of the data sub-sets I, II and III in Figure 6(a) are consistent with the seismic ray paths traversing a crust with velocities similar to those determined along the southwest coast (Fig. 4).

The data plotted in Figure 6(b) can be grouped into various sub-sets IV, V, VI AND VII all with the apparent velocities near 8 km/s. Sub-set IV is from stations on the Papuan Ultramafic Belt and is clearly associated with high velocity material relatively near the surface and steeply dipping refractors. Data sub-set V has a similar apparent velocity but the seismic travel times are influenced by the onshore structures of the Trobriand Platform's southern margin on which the recording stations Ioma (IA), Lamington (LMG), Gorari (GO) and Popondetta (PP) are situated. The arrivals recorded at Tetebedi (TT) and Afore (AF) are largely contained in sub-set VI and display a much less well defined trend than the other data sub-sets. Sub-set VI is similar to the transition data at distances between 150 and 180 km in Figure 5. The interesting point, however, is that the ray paths are all in the region northeast of the Owen Stanley Fault. Sub-set VII contains recordings from Musa (MD), which is also northeast of the Owen Stanley Fault, as well as data from KW, KP and CR, southwest of the Fault, and no further offset in the time-distance plot is apparent on crossing the Fault.

Thus it appears that longer (and presumably deeper) ray paths from shots along traverse J-L-N are evident under the Mount Lamington region as recorded at stations southeast of Mount Lamington. This feature is not apparent in data recorded at Tufi (TF) from the same shots but which may be inferred from recordings made at Salamaua(SL) and Kui (KU) from shots along line G-N (Finlayson et al., in prep.). It is also apparent from the data recorded at Musa (MD) from shots along traverse G-I that they fit into data set E in Figure 6(b). Thus the evidence for a deep 8 km/s layer described by Finlayson et al. (op. cit.) is substantiated and is certainly present under the Mount Lamington region.

An approximate model for the crustal structure under Mount Lamington can be determined by treating the line of stations, Gorari (GO), Lamington (LMG), Popondetta (PP), Killerton (KL) and shots out from the coast along traverse I-H (Fig. 2) as a fan-shooting pattern. Morobe (ME) and shot 85 have been chosen as one pair of reference points, and in the opposite direction Tufi (TF) and shot 55 have been chosen as the other pair. The travel-times from these reference points are illustrated in Figure 7.

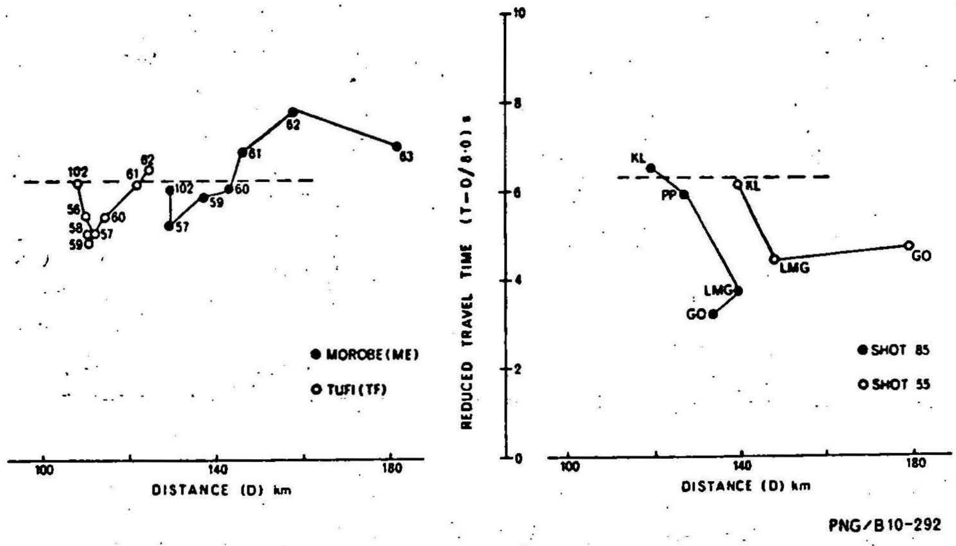

Fig.7 Delay-time differences along a line of stations and shots normal to the northeast Papuan peninsula coast.

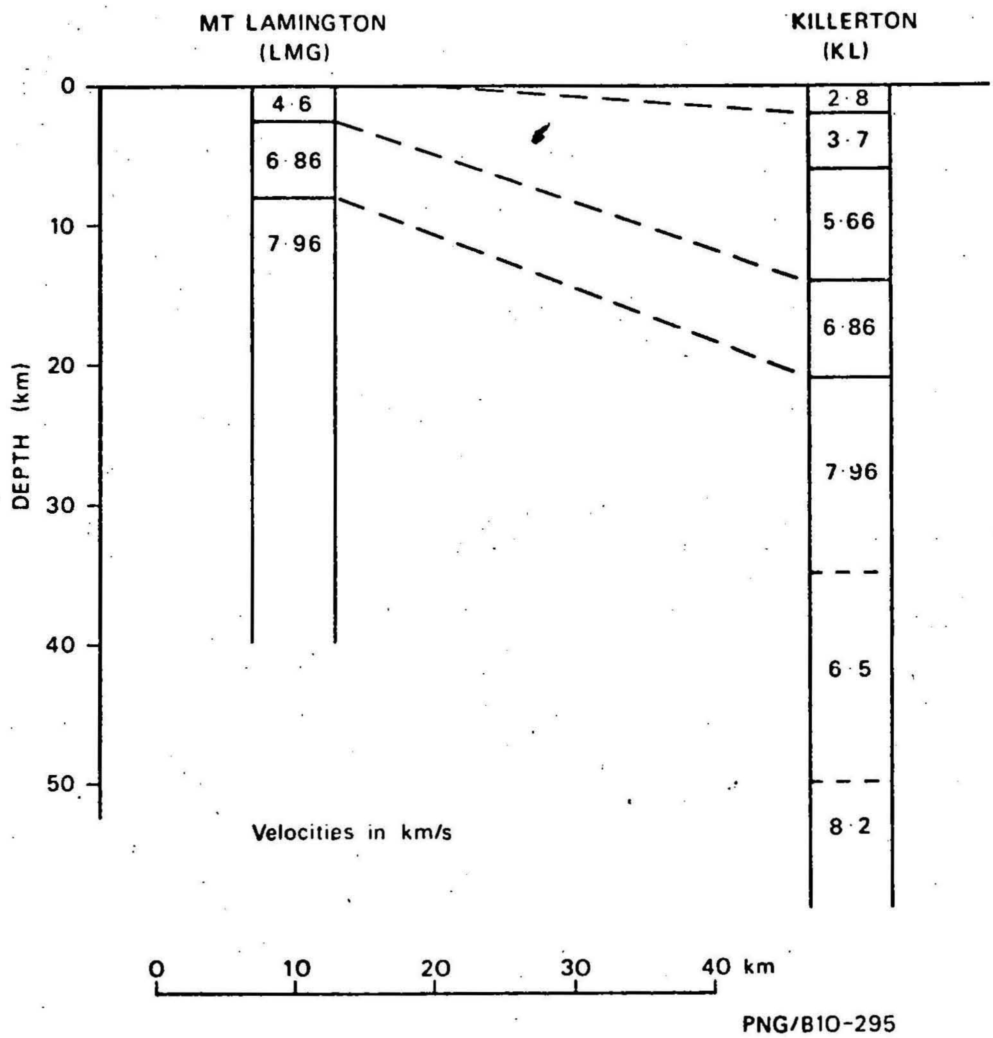

Fig.8 Simplified crustal structure under Mount Lamington.

The distances involved are all over 100 km and the ray paths can be regarded as being from a refractor with a velocity of approximately 8.0 km/s (Finlayson et al., in prep.).

It is apparent from Figure 7 that Killerton (KL) and shot 102 (closest shot to KL) have approximately the same delay-times to the "8.0" refractor. The delay-times decrease as one moves along the line of shots out from Killerton (KL). At shots 57, 58 and 59 the delay times are a minimum and the 1.1 s delay time difference from shot 102 can be attributed to thinning of the near-surface layer as the basement high is approached at the edge of the Trobriand Platform (CGG, 1971). The travel-times from shots in deeper water (60, 61, 62) indicate increasing delay-times, and these may be attributed to the structures on the submarine slope down from the Trobriand Platform to the floor of the Solomon Sea Basin (Finlayson et al., in prep.).

The right hand side of Figure 7 illustrates the considerable decrease in the delay times going from Killerton (KL) inland to Gorari (GO), the delay-time difference between Killerton (KL) and Lamington (LMG) being approximately 2.2 s. Aeromagnetic interpretation (CGG, 1971) indicates that sediment thickness decreases from approximately 3 km to zero along this line. The delay-time difference introduced by the near surface layers can be taken as approximately the same as that in the zone extending offshore to the basement high referred to above, i.e. 1.1 s. Interpretation of the aeromagnetic data later in this paper indicates that the basaltic province associated with the Papuan Ultramafic Belt extends under the Quaternary cover of the Trobriand Platform and the onshore areas northeast of the Owen Stanley Ranges, and that Mount Lamington is near its southwest boundary.

If the remaining 1.1 s delay-time difference between Killerton (KL) and Lamington (LMG) is attributed to a thinning of the basaltic and gabbroic layers and if the seismic velocity used for the volcanic pile is similar to that determined at Rabaul, i.e. 4.6 km/s (Finlayson & Cull, 1973), the structure under Mount Lamington can be extrapolated from the crustal structure under Killerton (KL) as shown in Figure 8. The depth to the deep "8.0" refractor can be approximated from apparent velocities and intercepts of data sub-sets III and VII in Figure 6, but detailed analysis of the low-velocity layer between the "8.0" refractors will be required in order to resolve the structure more accurately. Refractors may also dip considerably across the strike of the gross structures; if so, the refractor depths indicated would be offset from positions directly under Mount Lamington.

The first-arrival data from shot 56 to recording stations Killerton (KL), Popondetta (PP), Mount Lamington (LMG) and Gorari (GO) in Figure 5 have an apparent velocity of 8.4-8.5 km/s. This is the velocity to be expected if the 5.66 / 6.86 km/s interface dips at 13°-14° towards the Solomon Sea. However seismic modelling indicates that the velocity/depth distribution may vary from the simple layered section indicated in Figure 8 to one of smoothly varying velocity increase with depth for the layers above the 6.86 km/s refractor. The apparent velocity indicates that the dip of this refractor is slightly less than the 16° obtained from Figure 8. This is much less than the 25°-60° dips used by Milsom (1973) in his gravity models for the dipping structures of the Papuan Ultramafic Belt.

Seismic first arrivals from shots along traverse I-H (Fig. 2) at distances greater than 100 km towards the same recording station array mentioned above (KL, PP, LMG, GO) give apparent velocities of 9.4-9.7 km/s. Modelling indicates that such velocities would be apparent from the 6.86/7.96 km/s interface at dip angles of 12°-15° which are less than the 19° indicated in Figure 8. Further analysis will undoubtedly modify the simple dipping structures used in this paper.

MAGNETIC EXPRESSION IN THE MOUNT LAMINGTON AREA

Aeromagnetic surveys covering the eastern Papuan peninsula, the Gulf of Papua and the Trobriand Platform have been undertaken by BMR (CGG 1969, 1971, 1973). Figure 9 shows a composite map of these surveys over the Papuan Ultramafic Belt in the Mount Lamington region and includes the major geological faults. The eastern half was flown at 2400 m and the western half at 4600 m. The regional gradient used to produce the contour map was that given by Parkinson & Curedale (1962) for the epoch 1957.5, but the contour values are not tied to any reference field. The dip, declination and magnitude of the Earth's magnetic field in this region are approximately -31^{o}, $+6^{o}$E and 42,500 nT respectively (Finlayson, 1973).

The most obvious feature of the magnetic map is the prominent negative anomaly which is closely associated with the Papuan Ultramafic Belt particularly from Kui (KU) to Mount Lamington (LMG). Immediately south of Kui (KU) the negative anomaly is near the coast, and between Morobe (ME) and Cape Ward Hunt (CW) it is closer to the Owen Stanley Fault and shows rather irregular relief. South from Cape Ward Hunt it reflects the trends of the major faults indicated in Figure 9. The northernmost section of the Belt, which trends towards the coast near Salamaua (SL), is expressed by lack of relief in the magnetic contours.

In the region of Mount Lamington the anomaly is offset some 30 km to the south and its trend alters from southeast to east. The anomaly is very prominent in this area and the trend continues towards the east, but the relief of the anomaly is more irregular here than to the north of the offset. The magnetic expression of the Owen Stanley metamorphic zone southwest of the Papuan Ultramafic Belt is generally small except for a number of circular anomalies attributable to local intrusives.

In the northern part of the Belt the negative anomaly correlates

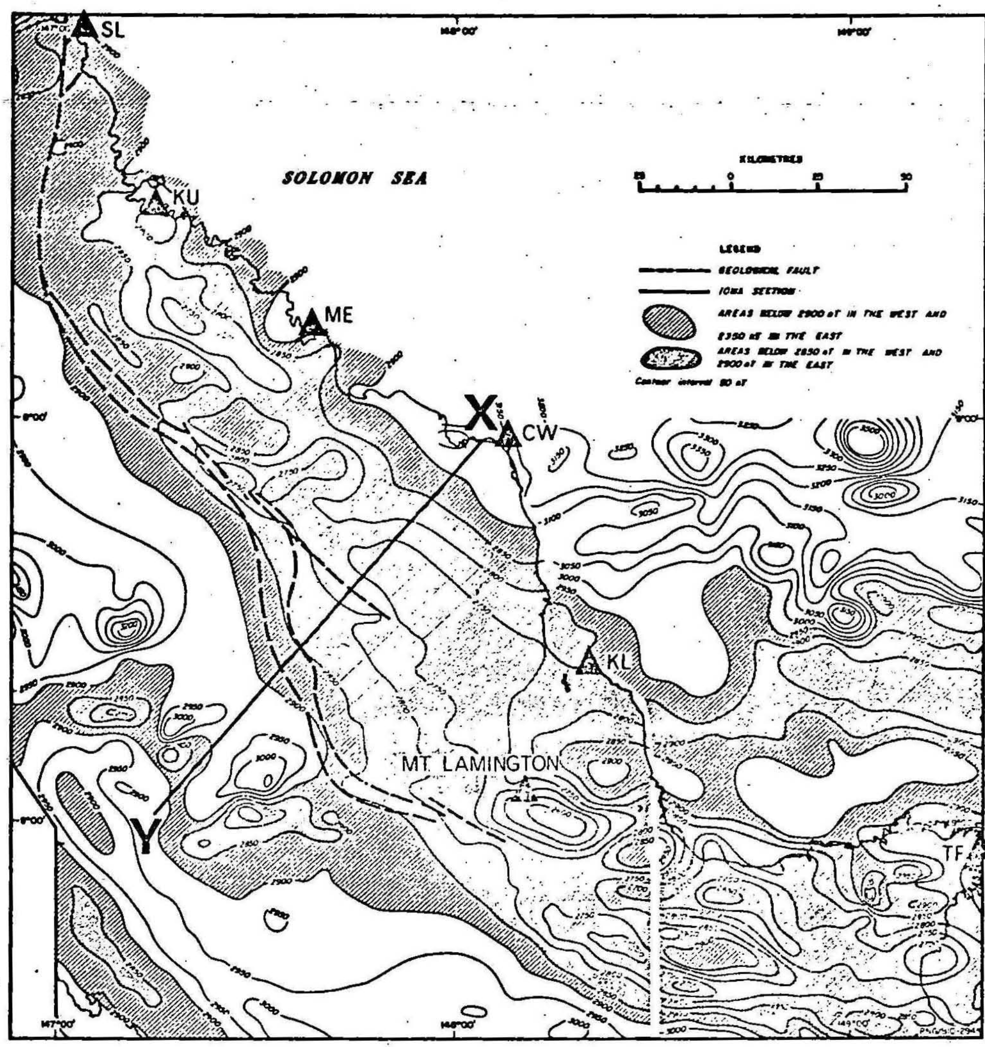

Fig.9 Aeromagnetic anomaly map of the Mount Lamington region.

well with two rock units mapped by Davies (1971) as the gabbroic and basaltic components of the ophiolite suite of rocks. Most of the areas mapped as being occupied by these two units have associated negative anomalies. Between Kui (KU) and Morobe (ME), however, the anomaly is rather irregular and does not correlate well with the large area of gabbro mapped in the region, an effect probably caused by the presence of numerous diorite intrusions in the area. The absence of magnetic expression in the most northerly part of the Belt reflects the absence of basalt and gabbro in this area and provides convincing evidence that the ultramafic component of the ophiolite suite has a very small magnetic effect.

Figure 10 shows three two-dimensional magnetic models along the profile XY (Fig. 9). The models show the effects of three layers with dip angles of about 9° and a natural remanent magnetism of 4 A/m in the direction of the Earth's present field. The terrain effects of the Owen Stanley Range are also included in the models. The three models illustrate the magnetic effects of the basalt, the basalt and gabbro, and the basalt, gabbro and ultramafic rocks with layer thicknesses corresponding to the measured surface exposures.

Although none of the fits is good, that produced by the basalt and gabbro model is closest. The observed anomaly has a longer-wavelength component than the calculated anomalies, indicating that an accurate magnetic model of the Papuan Ultramafic Belt must differ from Figure 10. Detailed magnetic studies of oceanic crust (Talwani et al., 1971; Atwater & Mudie, 1973) indicate that the magnetic material may not be uniformly distributed within the oceanic layers 2 and 3 and the non-uniqueness of magnetic interpretation methods makes it difficult to construct detailed models based solely on magnetic observations.

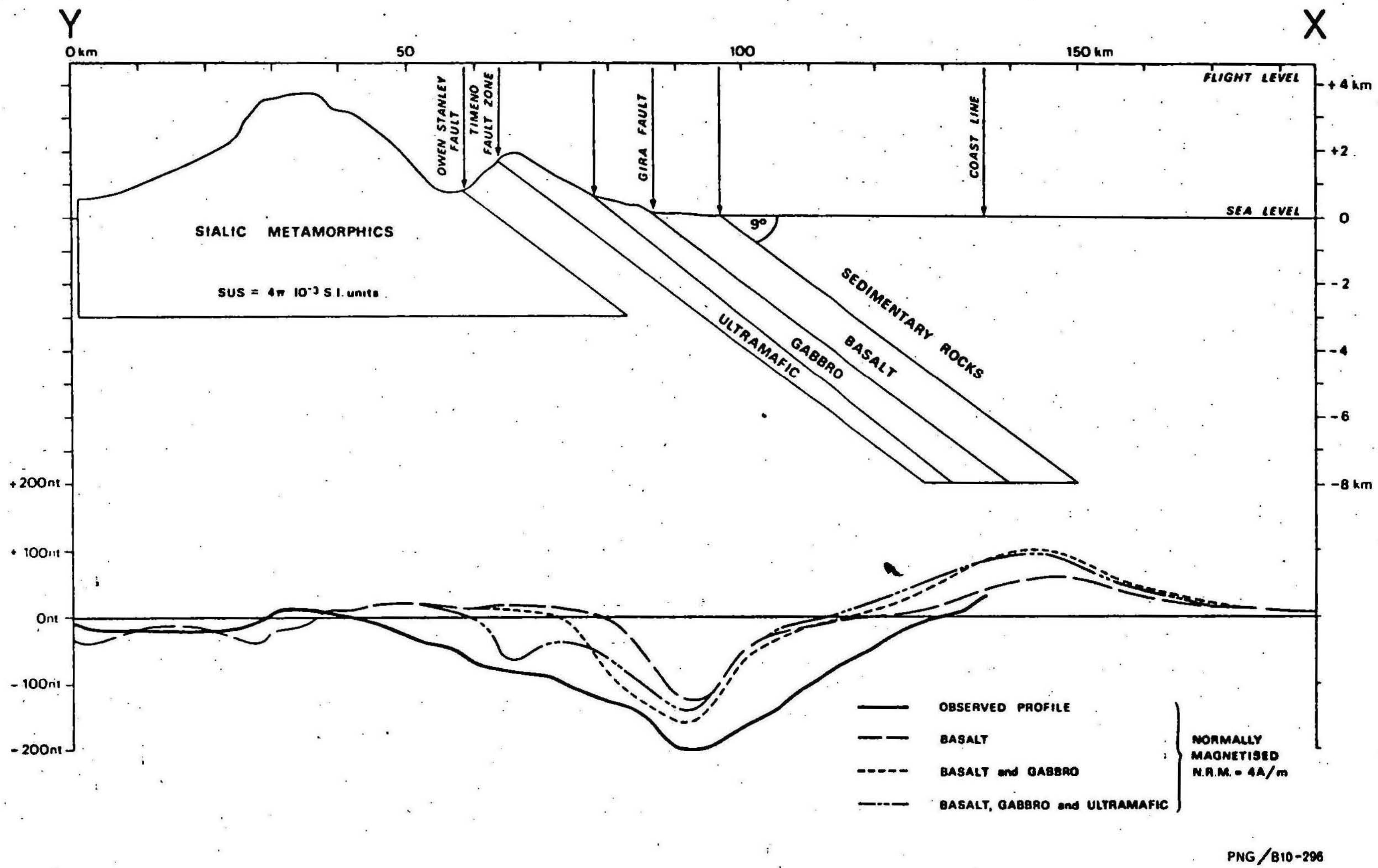

Fig.10 Magnetic models along the line X-Y shown in Fig.9.

The depth to the basalt layer at the coastline in Figure 10 is 6 km which agrees with the depth to the 5.66 km/s layer indicated in Figure 8 but is 2 km deeper than that indicated by Finlayson et al (in prep.) for the Cape Ward Hunt (CW) region. The dip of 9^{o} is less than the dip of the 6.86 km/s refractor in the Mount Lamington region determined from seismic work described earlier in this paper and within the range of topographic dips (5^{o}-15^{o}) on the sea floor towards the Solomon Sea basin (Finlayson et al., in prep.).

East of the magnetic anomaly offset mentioned earlier, outcrops of basalt and gabbro associated with the Ultramafic Belt are sparse and the main surface rock units are Quaternary volcanics and alluvium. However, the continuation of the regional negative magnetic anomaly suggests strongly that the basalt and gabbro units are present under the Quaternary cover. Their presence in this region has been postulated by Davies (1971) on geological evidence and by Milsom (1973) from the gravity modelling studies. The Quaternary volcanics have a relatively subdued magnetic expression. This may possibly be explained if they are composed of interlayered reversely and normally magnetized lava flows which would render them effectively non-magnetic. This effect was found in parts of Iceland (Piper, 1971).

The offset in the magnetic anomaly near Mount Lamington represents a boundary, possibly a north-south shear zone along which the Ultramafic Belt has been offset. Quaternary volcanics are prevalent east of the offset but absent to the west.

DISCUSSION

In eastern Papua the contemporary suites of calc-alkaline and high-K alkaline lavas (Johnson et al., 1970) associated with recent volcanism cannot be associated with any currently active well defined Benioff zone in accordance with the model that Jakes & White (1969) have proposed for island arc areas. Such lavas are usually associated with magma generation at depths greater than 150 km. The lithospheric structures at such depths cannot be determined from the seismic and magnetic survey work interpreted in this paper. The simplified crustal structure proposed here indicates that the concept of a slice of crust and upper mantle obducted onto a less dense crust is substantially correct in the Mount Lamington region, but the development of the thicker crustal section (twice that of normal oceanic crust) along the northeast Papuan peninsula coast (Finlayson et al., in prep.) requires further investigation.

The crustal shortening required to generate the Papuan Ultramafic Belt structures in the Eocene-Oligocene (40 m.y. B.P. approximately) cannot be directly related to present day volcanism in eastern Papua. However, the whole Melanesian region demonstrates episodic development since that time and is still a major interaction zone between the Australian and Pacific lithospheric plates. Thus it is possible that some latent geochemical separation has been maintained until the present to account for the current volcanic activity. A subduction episode of only 1-2 m.y. duration under east Papua would be sufficient to enable oceanic crust to descent to the 150 km depth which is generally considered necessary to generate calc-alkaline volcanics. It may be speculated that this has occurred since the emplacement of the Papuan Ultramafic Belt. A few earthquakes and hypocentres in the depth range 70 to 300 km have been detected in the Mount Lamington area and also in the Ioma (IA) area indicating that there is current lithospheric activity under east Papua.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contribution of the following institutions to the field work during the East Papua Crustal Survey: Research School of Earth Sciences, Australian National University; Department of Geology and Mineralogy, University of Queensland; Warrnambool Institute of Advanced Education; Preston Institute of Technology; Hawaii Institute of Geophysics, University of Hawaii; and the Geological Survey of Papua New Guinea. The staff of the Papua New Guinea, District Administration and many individuals rendered invaluable assistance with the logistic operations connected with the field work; the authors wish to thank them for their help towards the overall success of the survey. We also wish to pay tribute to the volcanological work of Tony Taylor who, with others, was instrumental in promoting and encouraging the deep seismic investigation of the Mount Lamington region of eastern Papua. This paper is published with the permission of the Director of the Bureau of Mineral Resources, Geology & Geophysics.

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