SEISMOTECTONICS OF WESTERN NEW GUINEA

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We study seismic activity and focal mechanisms in the vicinity of Indonesian New Guinea (Irian Jaya) in order to clarify the tectonics of this region. Epicentral distribution and vertical profiles of earthquake foci across New Guinea indicate that seismic activity is not associated with the two principal geologic features, the New Guinea Trench and the Medial Mountains, but rather is concentrated in the region between them. We find no seismological evidence of subduction along the New Guinea Trench west of 140°E; moreover, one well-constrained focal mechanism at the New Guinea Trench yields a strike-slip focal mechanism.

The region between the New Guinea Trench and the Medial Mountains is characterized by strike-slip faulting and reverse faulting. The focal mechanism of the 1979 $M_S=7.6$ Yapen Island earthquake off the northwestern coast of New Guinea suggests that active strike-slip motion is occurring along this portion of the Sorong fault system. Thrust-type mechanisms with one nodal plane dipping steeply to the northeast, including that of the 1971 $M_S=8.0$ earthquake, are most common in the Meervlakte Basin area between the northern coastal range and the Medial Mountains. Additional strike-slip faulting and thrust faulting are seen in the Tarera and Wandamen Fault Zones in Bird's Neck, and south of the Medial Mountain Suture Zone.

We suggest that the oblique convergence between the Caroline and Australian plates in western New Guinea is divided into the strike-slip component represented by the left-lateral shear motion along the major strike-slip fault systems and the dip-slip component represented by the intraplate thrusting such as the reverse faults in the Meervlakte Basin. East of 140°E along the New Guinea Trench, the Bismarck plates are subducting, producing the intermediate-depth seismicity beneath central New Guinea.

1. Introduction

The region of the southwest Pacific in the vicinity of the New Guinea landmass

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is widely regarded as one of the most tectonically complex areas of the world. The northern coast of New Guinea lies parallel to the boundary between the Australian plate to the south and a series of smaller plates to the north (Fig. 1). Several analyses of seismicity and tectonics in the New Guinea region have offered a variety of interpretations of the northern boundary of the Australian-Indian plate (e.g., DENHAM, 1969, 1973; JOHNSON and MOLNAR, 1972; EVERINGHAM, 1974; HEDERVARI and PAPP, 1977; PASCAL, 1979; HAMILTON, 1979; Dow and SUKAMTO, 1984; COOPER and TAYLOR, 1987). However, many of the specific relationships between local seismicity, focal mechanism solutions, geologic structures, and plate motions in the western New Guinea region have yet to be analyzed.

In this paper, we confine our discussion to the western half of New Guinea (Indonesian New Guinea or Irian Jaya and part of Papua New Guinea) west of 144°E. The New Guinea Trench is the principal geologic feature describing the boundary between the Caroline and Australian plates (Fig. 1, HAMILTON, 1979). WEISSEL and ANDERSON (1978) suggested that the Caroline plate exists as a separate microplate north of western New Guinea. Earlier papers concerned with seismicity and tectonics in the southwest Pacific referred to ocean crust north of western New Guinea as part of the larger Pacific plate (FITCH, 1970; HEDERVARI and PAPP, 1977). Whether the New Guinea Trench is a feature of active subduction beneath western New Guinea has been a subject of dispute. Topography and seismic reflection profiles across the New Guinea Trench display structural features characteristic of a zone of active subduction (HAMILTON, 1979). Previous studies of earthquakes in

![Fig. 1. Major plates in the southwest Pacific in the vicinity of New Guinea. The Caroline and Bismarck microplates form a buffer zone between the larger Australian and Pacific plates. The study area is New Guinea west of 144°E.](image-url)
western New Guinea (Fitch, 1970; Johnson and Molnar, 1972) have interpreted focal mechanism solutions also as an indication of subduction beneath the northern New Guinea coast. In this study, however, we demonstrate that seismic activity in the region is not associated with subduction but rather with collision deformation within the New Guinea landmass.

South of the trench, western New Guinea can be divided into four distinct geographic regions (Fig. 2). The northern Highlands along the coast and the Medial Mountain Range characterize the highlands of New Guinea. A lowland basin, the Meervlakte Basin and its eastern extension, separates the two mountain ranges. A foreland basin lies to the south of the Medial Mountains. In Fig. 2, we show the contour lines of the sediment thickness of these basins (Hamilton, 1979). Fault zones across western New Guinea trend either WNW-ESE or E-W (Dow and Sukamto, 1984; Hamilton, 1979, Fig. 3). The suture zone along the Medial Mountain Range represents the collision of a Mesozoic-early Tertiary paleo-island arc with the Australia-New Guinea landmass in the Miocene time (Hamilton, 1979).

Surface-trace faults belong to one of the two east-west trending left-lateral strike-slip fault systems, the Tarera and Sorong fault systems in the north and south coasts of western New Guinea (Fig. 3), or to the NW-SE trending Wandamen Fault Zone (Dow and Sukamto, 1984; Hamilton, 1979). The NE-SW trending Waipoga Trough southeast of Geelvink Bay is also estimated to be a fault (Dow and Sukamto, 1984).

The purpose of this study is to use the distribution and nature of earthquakes in
western New Guinea to determine whether specific tectonic features in the region are active or dormant. In this paper we discuss the results of twenty-four focal mechanism solutions for earthquakes occurring in western New Guinea from 1963 through 1982. By relating these focal mechanism solutions to seismicity distribution, geologic structures, and relative plate motions in the region, we can make general interpretations of current tectonics in the vicinity of western New Guinea.

2. Seismicity

2.1 Epicentral distribution

We plotted epicenters of shallow and intermediate-depth earthquakes in Figs. 3 and 4 in the vicinity of western New Guinea; these earthquakes are from the International Seismological Center (ISC) Bulletins and have twenty or more P-arrival times reported in the bulletins and occurred from 1964 through 1982. Shallow earthquakes are defined to be within 60 km of the earth’s surface while intermediate-depth events occur between 60–200 km. We find no earthquake across western New Guinea at depths greater than 200 km.

Two concentrated zones of shallow seismicity are evident between 138°E and 141°E. One of these zones lies in the Meervlakte Basin approximately 100 km south of the northern New Guinea coastline. A substantial number of the Meervlakte Basin earthquakes represent the aftershocks of the 1971 $M_S = 8.0$ earthquake. The second of these zones is centered near 140°E south of the Medial Mountain Suture Zone. Although these two regions lie within 100 km of each other, they appear to derive from different tectonic features as will be discussed later.

West of 138°E, there is a cluster of activity north of the New Guinea mainland in the vicinity of Yapen and Biak Islands and linear zone of activity along the Aru Trough in the south (Fig. 3). Other shallow activity is diffuse; they are distributed in northern Bird’s Head, in the Wandamen-Tarera Fault Zones and near the Waipoga fault.

Fewer intermediate-depth earthquakes have occurred in western New Guinea during the period 1964–1982 (Fig. 4); moreover, most of these earthquakes occur above 100 km depth as will be shown later. Seismic activity at intermediate depth remains generally diffuse west of 138°E. East of 138°E, one concentrated zone of activity exists beneath the Meervlakte Basin. Further to the east, seismic activity increases in a zone between the northern coast and the Medial Mountains.

2.2 Vertical cross sections

Vertical cross-section profiles of earthquake foci allow us to further examine the characteristics of earthquake distribution in the region. The cross sections of Fig. 5 were constructed to represent vertical profiles of events along planes roughly perpendicular to the New Guinea Trench. All seismic activity occurring within a rectangle along the projection line in Fig. 5a was plotted onto that profile (Fig. 5b). The earthquake foci are classified into the three groups according to the
Fig. 3. Shallow seismicity (focal depth <60 km) of western New Guinea occurring from 1964 through 1982 reported in the ISC Bulletins with twenty or more P-arrival times. Geologic features are from Hamilton (1979) and Dow and Sukamto (1984). Activity is seen in the Meervlakte Basin, in the northern coast, and in the major fault zones in western New Guinea.

Fig. 4. Intermediate-depth seismicity (focal depth 60–200 km) of western New Guinea occurring from 1964 through 1982 reported in the ISC Bulletins with twenty or more P-arrival times. Three focal mechanisms for intermediate-depth events listed in Table 1 are also shown. Seismic activity has diminished significantly with depth relative to Fig. 3. Epicentral distribution in the Meervlakte Basin is similar to the distribution of shallow events in this region.
depth control for each event. The criterion similar to that used by CARDWELL and ISACKS (1978) in the Sunda arc is used: Class A (good), having pP-P depth reported in the ISC Bulletins or \( h(\text{depth})/\Delta(\text{epicentral distance}) > 0.7 \); Class B (fair), \( 0.2 < h/\Delta < 0.7 \); and Class C (bad), \( h/\Delta < 0.2 \). In the cross sections, they are indicated by the open circles, small closed circles, and the plus symbols for Classes A, B, and C events, respectively.

In section A-A', a diffuse zone of events appears in the Sorong fault system. Seismicity south of it is associated with the Wandamen Fault Zone. Earthquakes along the southwestern edge of this profile correspond to offshore seismic activity in the Seram Trough, outside the region of interest. Section B-B' traverses Yapen Island and the southern and eastern edges of Geelvink Bay. Consequently, more earthquakes are visible south of the Sorong fault relative to section A-A'. They are the activity associated with the Wandamen and Tarera Fault Zones, Waipoga fault, and northern part of the Aru Trough.

In the both profiles above, earthquakes are confined mostly above a depth of 100 km. Seismic activity is scarce near the New Guinea Trench and we fail to observe any indication of subduction beneath the New Guinea landmass.

Sections C-C' and D-D' show a different character than the profiles further west. Section C-C' encompasses the Meervlakte Basin where earthquakes form a band of activity less than 100 km wide; this appears in the section as a cluster of activity beneath the basin. This activity is mostly the aftershock activity of the 1971 \( M_s = 8.0 \) earthquake. The depth of this activity ranges from the surface to the depth of 100 km. Because this includes Rank A and B events, and the hypocenters reported in the ISC Bulletins have usually an error less than 20 km in the New Guinea region if the number of P-arrival times reported is large (COOPER and
Fig. 5. Vertical profiles of earthquakes across western New Guinea occurring from 1964 through 1982 reported in the ISC Bulletins with twenty or more P-arrival times. (a) Cross-section lines. All events within each rectangle are projected in the vertical section along the line. (b) Cross-sections. In sections A-A' and B-B', activity is shallow and does not indicate any subduction polarity. In sections C-C', intense activity beneath the Meervlakte Basin and a southward dipping slab-like feature are seen; the latter feature is more clearly seen in section D-D'.

Fig. 5(b)
TAYLOR, 1987), we regard the activity distributed nearly vertical, rather than shallow dipping. However, future studies, including those applying the joint hypocentral determination method or synthesizing seismograms, may be necessary to confirm this. Overlapping this activity, a zone of activity at intermediate-depth and dipping gently to the southwest can be seen. This feature becomes more evident to the east in section D-D', and may represent a slab subducting from the New Guinea Trench. Section D-D' displays a seismicity distribution characteristic of a southwestward-dipping slab. Northeast of the New Guinea Trench, no seismicity is observable but an inclined seismic zone dips southwestward from the trench. This southwestward-dipping zone of activity is also identified in the cross sections in this region and to the east presented by PASCAL (1979), DENHAM (1969), and COOPER and TAYLOR (1987).

3. Focal Mechanisms

We obtained fourteen new focal mechanism solutions from shallow and intermediate earthquakes (m_b or M_s > 6.0) for the period from 1963 through 1979. We constructed the mechanism diagrams of Fig. 6 from seismograms of WWSSN; each focal mechanism is displayed as an equal-area projection of the lower focal hemisphere. A set of parameters for each earthquake is presented in Table 1. Data from two of these events (events 8 and 13) were provided by R. Cardwell (pers. comm., 1982). Additionally, in this table, we include solutions previously obtained by FITCH (1970), JOHNSON and MOLNAR (1972), and RIPPER (1977), and five solutions listed in the Harvard University CMT catalogue for the period 1980–1982 (e.g., DZIEWONSKI and WOODHOUSE, 1983). Mechanism solutions of events 4, 5, 8, 9, and 19 (Fig. 6) are newly constructed in this study but they are also contained in the previous studies.

Earthquake depths are from the ISC Bulletin; none of the earthquakes have been relocated because ISC hypocenters for moderate-size events (m_b or M_s > 6) mostly have errors less than 20 km and thus appear to represent reasonably tectonic features on a regional scale (COOPER and TAYLOR, 1987). We use the format of SENO and KURITA (1978) to rank the reliability of each focal mechanism solution. A rank of “A,” “B,” or “C” for each earthquake depends on whether the number of constrained nodal planes in a given mechanism is two, one, or zero, respectively. When possible, the polarization angles of long-period S-waves were used to constrain the nodal planes of the focal mechanisms. We will discuss the events in terms of geographic location from northwest to southeast but the number associated with each earthquake refers to Table 1. In Fig. 7, focal mechanism solutions for the shallow (h < 60 km) earthquakes are plotted along with principal geologic and tectonic features. Focal mechanism solutions for the intermediate-depth earthquakes are plotted in Fig. 4.

The three earthquakes (events 11, 16, 19) located off the northern New Guinea
Fig. 6. Focal mechanism solutions newly obtained in this study for 14 earthquakes. Solid and open circles represent compression and dilatation P-wave first motions plotted in the equal area net of the lower focal hemisphere. The arrows indicate S-wave polarization angles. The fault parameters are listed in Table 1.

coast are indicative of active strike-slip and thrust faulting in the region. Even 16, centered near the New Guinea Trench, is a well-constrained strike-slip fault with nearly vertical nodal planes. Since western New Guinea is characterized by at least two major left-lateral fault systems, we interpret this focal mechanism as describing left-lateral strike-slip faulting along the New Guinea Trench across a fault plane striking approximately E-W.

Events 11 and 19 are located within the activity near Yapen Island. The focal mechanism of event 19 was constructed for the large 1979 $M_S=7.6$ earthquake. Because of the large magnitude of this event, we were unable to measure S-wave
Table 1. Parameters for 24 western New Guinea earthquakes from 1963 through 1982.

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Data for the epicentral location, depth and magnitude are from the ISC and ISS Bulletins. φ, δ, and λ denote strike, dip, and slip angles, respectively. AZ denotes azimuth and PL, plunge. Rank represents the reliability of each focal mechanism solution. A denotes the case that both of the nodal planes are well-constrained, B the case that only one of the nodal planes is well-constrained, and C the case that neither of the nodal planes is well-constrained. In the column Ref, JM denotes JOHNSON and MOLNAR (1972); F, FITCH (1970); R, RIPPER (1977); CMT, CMT solution in Harvard Univ. Catalogue. * Same-day aftershock of event 9.
Fig. 7. Focal mechanisms for 21 shallow events in western New Guinea listed in Table 1 superimposed on a map of seismicity and geologic features. Events in the Meervlakte Basin and northern coast show thrust-type mechanisms with one nodal plane dipping to the southwest with a low angle. Strike-slip-type events are associated with the major fault zones in western New Guinea.

polarization at any of the WWSSN stations; however, P-wave first-motions produced a well-constrained strike-slip solution. As Fig. 7 suggests, this earthquake occurred along a main branch of the Sorong fault system. The nearly E-W strike of one nodal plane coincides with the assumed E-W alignment of the Sorong fault in the vicinity of Yapen Island. Despite the lack of direct geologic evidence for active faulting in the Sorong Fault Zone (HAMILTON, 1979; DOW and SUKAMTO, 1984), this recent Yapen Island event indicates that strike-slip faulting is occurring along the Sorong fault in the Geelvink Bay region.

The aftershock activity of the 1979 event first propagated in an E-W direction, then during the ten days after the mainshock it also extended to the NNE-SSW direction (TAJIMA and KANAMORI, 1985). The NNE-SSW trend of seismic activity can be seen for the period before the 1979 earthquake, if we plot earthquakes for this period. Consequently, much of the seismic activity in this zone may correspond to a conjugate fault of the Sorong fault system. Event 11 is located in the conjugate fault zone (Fig. 7) but produced a dip-slip mechanism with one steeply dipping nodal plane. The mechanism solution of this event is similar to those of the events in the Meervlakte Basin area (events 2, 14, and etc.), and may represent that the intraplate deformation in the basin area is extended to this location. Otherwise the thrust zone south of the New Guinea Trench, branched from the trench north of Bird’s Head at 0°N, 132°E (HAMILTON, 1979), may extend to this location.

Events 1, 6, 8, and 13 represent earthquakes in the southwestern portion of western New Guinea. The mechanism solutions of events 1 and 8 imply either a very
low-angle thrust or vertical faulting striking parallel to the fault zone near the earthquake epicenters. Dow and Sukamoto (1984) reported a thrust, the Weyland Thrust, dipping to the north from the eastern end of the Tarera Fault Zone (Fig. 7); these events may represent low-angle thrusting motions at this thrust. Otherwise, they may represent vertical faulting associated with the horsts on the Weyland Thrust reported by Dow and Sukamoto (1984).

Focal mechanism solutions for events 6 and 13 indicate active strike-slip faulting in southwestern New Guinea. The nodal-plane orientations of these events are nearly equivalent. Consequently, if the planes striking southwest-northeast in each solution are the fault planes for these events, then we infer that these earthquakes are associated with the left-lateral movement along the Tarera Fault Zone of southwestern New Guinea. The location of these events and the seismicity distribution in the region (Fig. 3) both suggest that active faulting stretches from the Aria River Valley (Fig. 2) offshore into the Aru Basin.

Events 2, 3, 4, 7, 9, 10, 12, and 14 are located in the concentrated zone of seismic activity in the Meervlakte Basin area (event 4 is shown in Fig. 4). Each of the focal mechanism solutions of these events exhibits one nodal plane striking approximately northwest-southeast and dipping steeply to the northeast. The P-wave first motions of the $M_S = 8.0$ 1971 earthquake (event 9) allow us to constrain only the steeply dipping nodal plane. We assumed a pure dip-slip fault for this case. Other focal mechanisms in the region are similar in appearance to that of event 9 but with varied levels of the constraint on their nodal planes.

These events seem to represent the same mode of deformation in this area. Many of the depths of these events are from pP-P readings and thus likely to have good quality. They range from 30 to 63 km. In section C-C' of Fig. 5b, these events belong to the concentrated nearly vertical activity beneath the Meervlakte Basin and are not associated with the deeper activity inclined southwestward. Therefore we regard the nearly vertical nodal plane of the mechanism solutions of these events as the fault plane, although we cannot completely preclude, at present, the possibility that these events represent low-angle thrusts dipping to the south. We infer that strong compressive forces, resulted from the convergence between the Caroline-Bismarck and Australian plates, are active within the landmass of western New Guinea producing a zone of high-angle overthrusting in the Meervlakte Basin region.

Events 17, 18, and 22 are located south of the Medial Mountain Suture Zone (Fig. 7). The mechanism solutions for events 18 and 22 are characterized by strike-slip faulting with the P-axis directed northeast-southwest. They are presumably on a fault trending E-W as shown by a linear zone of seismic activity. This faulting would have resulted from the compressive force in the NE-SW direction due to the convergence of the two plates, similarly as those in the Tarera and Sorong Fault Zones.

Event 17 has a very different mechanism solution, one nearly vertical nodal plane striking northeast-southwest. If this earthquake corresponds to high-angle
reverse faulting, the orientation of its P-axis is anomalous compared to those of the nearby earthquakes. At present, the tectonic significance of this event is unknown. Similar diversity in the distribution of P-axes is seen also for the solutions shown by COOPER and TAYLOR (1987) in this region; in their Fig. 4, there are NW, N, and NE trending P-axes. In the mechanism solutions above, we cannot see any indication of the south-vergent underthrusting motion of the Australian continent beneath the Medial Mountains, which is inferred geologically (HAMILTON, 1979), although COOPER and TAYLOR (1987) suggested this thrusting from the seismicity distribution and one focal mechanism in the region further southeast.

Near the junction of the transform fault in the Bismarck Sea with the New Guinea coast, we find thrust-type and strike-slip type mechanisms (events 5, 21, 23, and 24). Thrust-type mechanisms (events 21, 23, and 5), with additional strike-slip components, may represent the Bismarck plates underthrusting beneath the New Guinea landmass. In contrast, event 24 shows a strike-slip fault, which may represent the left-lateral motion between the north and south Bismarck plates (e.g., TAYLOR, 1979; COOPER and TAYLOR, 1987; EGUCHI et al., 1987). The solutions for the two intermediate events (events 15 and 20, Fig. 4) represent down-dip compressional events within the slab subducting from the New Guinea Trench seen in section D-D'.

4. Discussion

Two principal questions are raised by the data presented in this study: (1) What is the effect of the relative motion between the Caroline and Australian plates on the distribution of fault zones in western New Guinea? and (2) Why has subduction ceased along the western portion of the New Guinea Trench?

4.1 What is the effect of the relative motion on the distribution of fault zones in western New Guinea?

The Caroline plate is juxtaposed to western New Guinea west of 140°E and the Bismarck plates to the central part of New Guinea east of 140°E (Fig. 1). We calculate a convergence rate of 11.1 cm/yr and a direction of N65°E for the Caroline-Australian plate motion from the recent solutions for the motions between the Philippine Sea, Caroline, and other major plates by SENO et al. (1987). Clearly, the tectonic features of western New Guinea must be derived from the oblique convergence between the Caroline and Australian plates. Figure 8 shows schematically the modes of deformation of the New Guinea landmass derived from the seismicity and mechanism solutions in this study. In this figure we also plotted the relative motion between the Caroline and Australian plates (large white arrows).

FITCH (1972) proposed that an oblique convergence vector can be separated into normal and shear components. The normal component of convergence is responsible for underthrusting or compressional tectonic features while the lateral component results in transcurrent faulting. Examples of oblique-plate-convergence
Fig. 8. Map view of the mode of deformation of the western New Guinea landmass revealed from the focal mechanisms in this study. The convergence vector between the Caroline and Australian plates shown by the large white arrows are calculated from Seno et al. (1987). The oblique convergence is shared with the strike-slip faulting along the Sorong and Tarera fault zones and the major reverse faulting in the Meervlakte Basin (solid arrow) and the minor reverse faulting in the other areas (small white arrows).

systems occur throughout the western Pacific including the Sumatra and Philippine zones (Fitch, 1972). In western New Guinea, the consequences of oblique convergence are more complex and demonstrated in intraplate deformation. Transcurrent movement is evident in the left-lateral Sorong and Tarera Fault Zones. By comparison, the normal component of convergence appears to be instigating internal deformation of the Australian plate rather than active subduction along the New Guinea Trench.

East of 138°E, we have identified a southwestward-dipping Wadati-Benioff zone at intermediate depth, which is more active east of 141°E. This slab-like feature beneath the central portion of New Guinea, which has already been identified in the previous studies, may represent the subducted North and South Bismarck plates, if we take into account the oblique convergence vector shown in Fig. 8. As the slip vectors of the thrust-type events indicate, the convergence of the North Bismarck plate (events 21 and 23) is more oblique than that of the South Bismarck plate (event 5), as expected from the left-lateral motion between these two plates.

West of 138°E, we see no indication of subducted slab beneath western New Guinea. Major deformation takes place within the continental lithosphere at depth shallower than 60 km. Figure 9 shows our proposed model for the deformation of western New Guinea west of 138°E in cross section normal to the trench. Two major strike-slip fault zones, the Sorong and Tarera Fault Zones, and the E-W
Fig. 9. Cross section of the mode of deformation of the western New Guinea landmass west of 138°E. The New Guinea Trench is a relic of ancient subduction while convergence is taken up mostly by the left-lateral strike-slip fault zones and reverse faulting in the basin area. The Medial Mountain Suture Zone is also a relic feature.

4.2 Why doesn't subduction occur along the New Guinea Trench in its western part?

The answer to this question is complex but we can examine the problem in more detail by considering the tectonic history of the region. In the late Mesozoic-middle Tertiary, the New Guinea landmass defined a stable continental shelf north of Australia (HAMILTON, 1979). To the north, this shelf was attached to a slab subducting northward beneath an Paleogene Island arc. This island arc migrated southward and collided with New Guinea in the early-middle Miocene (HAMILTON, 1979). HAMILTON (1979) suggested that this collision reversed the polarity of subduction and induced a southward subduction in the late Miocene. He also suggested that the northward subduction beneath the Paleogene island arc during
the Oligocene produced the Caroline Basin as a back-arc basin.

Honza et al. (1987) and Honza (1988) proposed a different tectonic evolution model. In their scenario, the collision of the Paleogene Island arc and the succeeding arc polarity reversal occurred in the early Oligocene. The Oligocene southward subduction produced a back-arc basin between the Medial Mountains and the northern coastal range. In the middle-late Miocene, subduction began at the both sides, south and north, of this basin and has consumed the basin as manifested at present in the Solomon Sea. In the western Solomon Sea, the New Britain and Trobriand Trenches are consuming the Solomon Sea basin with a suture zone onland northwest of the Solomon Sea (Ripper, 1982; Honza et al., 1987; Cooper and Taylor, 1987). Honza et al. (1987) inferred that this collision occurred over the entire New Guinea coast and has migrated eastward.

The tectonic history in the New Guinea region does not seem so simple as described above. In Miocene time, the Solomon-New Britain arcs are likely to have been located much more east of the present position, as Hamilton (1979) suggested, if we take into account the convergence between these arcs and Australia since the late Miocene. The collision of the New Britain arc and Papuan Peninsula would have occurred only after a westward migration of the former over a long distance. Similarly the Caroline Basin, which formed during the Oligocene (Weissel and Anderson, 1978), might have been located thousands of kilometers east of the present position when it formed, unless there has been a significant differential motion between the Caroline and Pacific plates. The Miocene southward subduction, suggested by Hamilton (1979), may have occurred beneath New Guinea after the collision of the Paleogene Island arc, but the subducting oceanic plate would be different from the microplates juxtaposed to New Guinea at present. As we have shown, the Wadati-Benioff zone beneath central New Guinea is only seen beneath the place where the Bismarck plates are juxtaposed in the direction of the plate convergence. This suggests that the present subduction between 140°-144°E along the New Guinea Trench may be related to the formation of the Bismarck Sea. A simple tectonic history such that the collision zone between the New Britain (West Melanesian) arc and the New Guinea landmass was extending westward to the north of Bird’s Head and the southward subduction initiated successively after the collision as suggested for the region between 140°E-142°E by Cooper and Taylor (1987) does not hold in western New Guinea because there is no subduction in the west. At present it is not easy to answer why subduction of the Caroline plate beneath western New Guinea does not occur but intraplate collision deformation takes place. Similarly we cannot easily elucidate the origin of the Caroline Basin or why it is now juxtaposed to central-western New Guinea. We have to know more about the geology of the northern New Guinea region to depict any more realistic tectonic evolution history of this region.
5. **Conclusions**

The seismicity and focal mechanisms in western New Guinea show that the oblique convergence between the Caroline and Australian plates is divided into the left-lateral strike-slip motion along the major transcurrent fault zones and the dip-slip motion in the reverse faults in the lowland basin between the northern coastal range and the Medial Mountains. Almost no seismicity is associated with the two principal geologic features, the New Guinea Trench and the Medial Mountain Suture Zone. Beneath central New Guinea, the intermediate-depth seismic activity constitutes a southwestward dipping slab down to the depth of 150 km. Taking into account the obliquity of the convergence vector, this slab may indicate the subduction of the Bismarck plates between 140–144°E. Why the plate consumption is manifested by the extensive intraplate deformation in western New Guinea and not by the subduction of the Caroline plate is a difficult question to answer with the present poor knowledge of the tectonic evolution history in the New Guinea region. More work should be done on this aspect in the future.

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