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OFFSHORE TERTIARY SEDIMENTARY BASINS IN INDONESIA+)

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R I N G K A S A N

Cekungan-cekungan sedimen berumur Tersier yang kaya akan minyak dan gas bumi terutama terdapat di bagian barat Indonesia. Cekungan-cekungan ini dahulunya disebut sebagai "ideo-geosynclines", dan terdapat sekeliling tepi suatu masa daratan pre-Tersier yang diperkirakan dan dinamakan "Sunda Shelf". Dewasa ini daerah tersebut ditutup oleh laut - laut Epi-kontinental yang dangkal (Laut Jawa, Laut China Selatan). Bahagian luarnya cekungan-cekungan ini dibatasi oleh busur kepulauan volkanik dalam.

Penyelidikan-penyelidikan seismik lautan yang sangat luas, yang dilakukan baru-baru ini dan disusul oleh pengeboran telah membuktikan adanya penerusan dari beberapa cekungan ini ke lepas pantai (antara lain Sumatra Utara, Jawa Barat, Jawa Timur dan Kalimantan Timur). Lebih penting lagi penyelidikan tersebut telah membuka tabir bahwa paparan Sunda yang semula

+) This paper was presented at the Twelfth Pasific Science Congress in Canberra, Australia on 18 - 27 August 1971. Although to date numerous drilling has been conducted offshore, the basic outline given in this paper remains fairly well the same, with few minor revisions, while more oilfields have been discovered offshore.

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diperkirakan bertindak sebagai sumber-sumber sedimen selama "Tersier" dalam kenyataannya terdiri dari banyak cekungan-cekungan sedimen dan peninggian-peninggian yang memisahkannya, dan hanya daerah antara Bangka, Belitung serta kepulauan Natuna-Anambas adalah daratan Sunda yang sebenarnya. Peninggian - peninggian ini bertindak sebagai sumber dari berbagai lapisan sedimen dan beberapa diantaranya diwakili oleh pulau-pulau pre-Tersier antara lain Bangka, Belitung dan Karimun Jawa.

Pematahan bongkah dari batuan dasar ternyata bertanggung jawab atas perkembangan cekungan-cekungan ini, dan juga mengendalikan pengendapan maupun tektonik dari lapisan Tersier yang menutupinya. Selanjutnya explorasi lepas-pantai juga telah membuktikan adanya lapisan-lapisan sedimen tersier di antara Busur Kepulauan Volkanik dalam (misalkan Sumatra) dan busur Non-volkanik luar (pulau Nias dan lain-lain). Sampai saat ini belum terdapat cukup data-data untuk membahas cekungan sedimen lepas-pantai di Indonesia Timur.

Penyelidikan-penyelidikan geofisika laut dan pengeboran masih dalam kemajuan dewasa ini. Lokasi-lokasi pengeboran lepas-pantai masih sangat banyak yang direncanakan untuk tahun-tahun yang akan datang, sehingga masih terlalu pagi untuk membahas implikasi-implikasi geologi yang luas.

A B S T R A C T

Prolific Tertiary sedimentary basins are mainly located in Western Indonesia. They have previously been described as "ideo-geosynclines", and are situated around the periphery of a supposed pre-Tertiary land-mass the "Sunda Shelf", now largely covered by shallow epicontinental seas, (Java Sea, South China Sea). Outward they are bordered by the Inner Volcanic island arc.

Recent extensive marine seismic investigations and subsequent drilling have confirmed the extension of some of these basins offshore (e.g. North Sumatra, West Java, East Java and East Kalimantan). More important, however, *these surveys have revealed that the "Sunda Shelf" which supposedly served as source of sediments during the Tertiary, actually consists of numerous sedimentary basins and intervening uplifts, leaving the area between Bangka-Billiton and Natuna-Anambas Islands as the Sunda-land proper. These uplifts served as source of sediments and some are represented by pre-Tertiary islands, e.g. Bangka, Billiton and Karimun Jawa. Basement block-faulting is apparently responsible for the development of these basins, and controlled depositions as well as tectonics of the Tertiary cover. Further offshore exploration has also confirmed the presence of Tertiary sediments between the Inner Volcanic islands (c.q. Sumatra) and the Outer non-volcanic arc (c.q. Nias).*

There is no sufficient data to date to describe offshore sedimentary basins is eastern Indonesia. Marine geophysical surveys and drilling are still in progress at present. Numerous offshore drilling locations are scheduled for several years, so that it is still too preliminary to discuss the broad geological implications.

INTRODUCTION

Tertiary sedimentary basins of Indonesia have been known as prolific oil producer. Unfortunately the geology of these basins is little known except in general outlines. Since the work by Van Bemmelen (1949) very little has been published, since relatively little geologic investigations have been conducted. Previously the results of oil companies exploration work could not be published due to the competitive nature of the industry. Publications by Dufour (1957), Phillipi (1957), Wennekers (1958) and Weeda (1958) and also as outlined by Koesoemadinata (1969) on the oil basins of West Indonesia are largely based on pre-World War II data. The voluminous work by Hermes and Vischer (1962) on the results of petroleum exploration in West Irian is one single great contribution on the geology of Indonesia by the industry. A more recent publication on the South Sumatra basinal area has shed more light on the nature of sedimentary basins (Pulunggono, 1969).

The nature of the present day petroleum industry in Indonesia makes it possible to compile the results of petroleum exploration throughout Indonesia. At present basin studies are being undertaken in many parts of Indonesia. Very significant contribution to the knowledge of the regional geology of Indonesia is the result of offshore exploration which has been conducted extensively in Indonesian waters since 1967. Modern marine geophysical methods and processing techniques followed by fast modern offshore drilling make it possible to obtain geological insight within relatively short period of time. This in turn also contributes much to our understanding of the geology of the onshore basins. Some of the results of offshore exploration in western part of the Java Sea was presented by Todd and Pulunggono (1971) at the American Association of Geologists meeting in Houston, Texas.

This paper will deal with the preliminary results of offshore exploration in Indonesia. No details can be given, as exploration work is still progressing at an ever increasing speed. Many wells are scheduled to be drilled for many years to come, more detailed seismic work are still being undertaken. This paper is not based on an intensive study, but largely on day to day knowledge as exploration progresses. Evaluation of geologic data and intensive basin studies based on offshore as well as onshore exploration results are being undertaken, and will undoubtedly contribute a great deal to the geology of Indonesia.

MAJOR TECTONIC FRAMEWORK

The Indonesian Archipellago consists of island-arc systems, typical of the western pacific. A discussion on the island-arc nature of Indonesia is given elsewhere in this Congress by our colleague (Katili) and will not be repeated here. This island-arc system enclosed main shallow shelf sea areas, which are also large tectonic - physiographic features; the wellknown Sunda Shelf and the Sahul Shelf (Figure 1). The first belongs to the continent of Asia, and the latter to that of Australia, while in between are oceanic basin deeps. Although both shallow seas are presently the scene of active exploration for oil, much more has been known about the Sunda Shelf, so that this paper will primarily deal with Tertiary basins in the western part of Indonesia.

The following major positive tectonic elements may be recognized (Figure 2):

1. *The Sunda-Platform (Sunda Shelf ss.);* which is formerly thought to cover the entire Java Sea and South China Sea. It is now recognized to extend only between Bangka-Billiton Ridge in the south, and the Anambas and Natuna Ridges in the north. It consists primarily of consolidated pre-Tertiary sediments, which are locally metamorphosed and

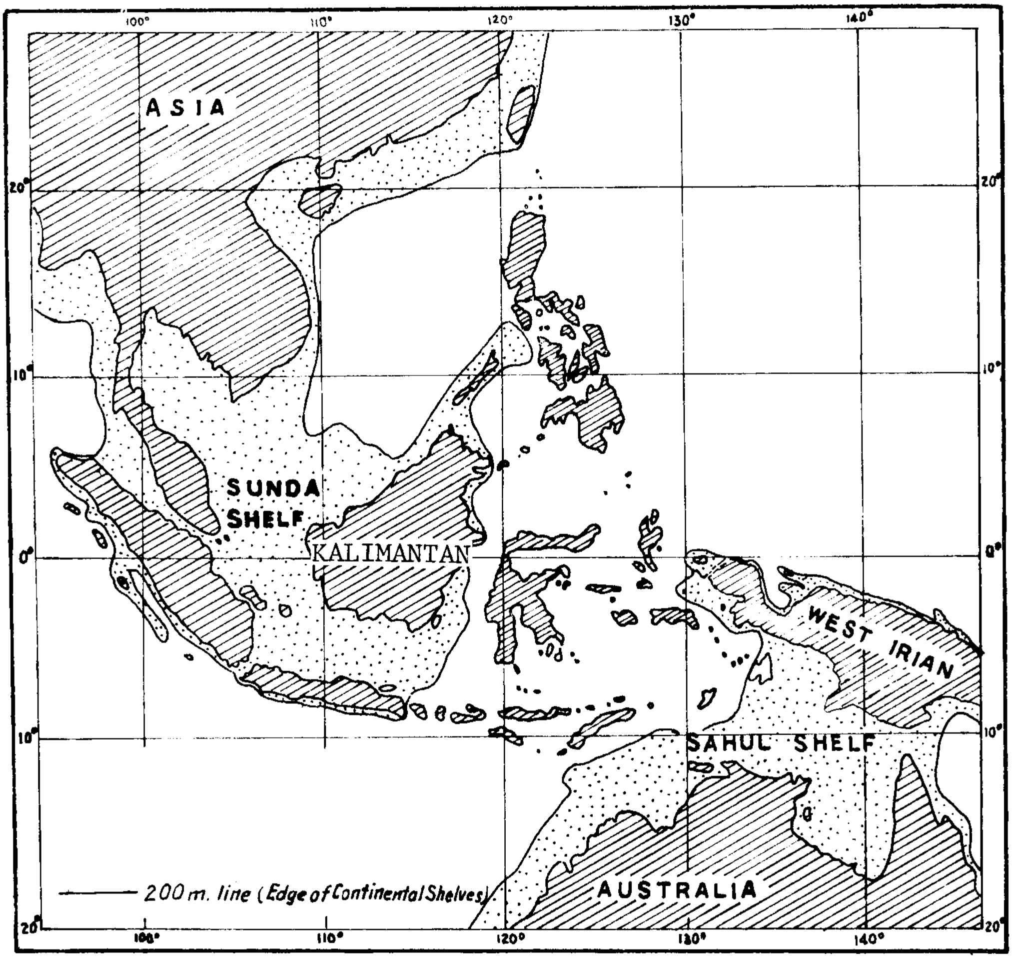

Figure 1: Map of Indonesia showing shelf seas

igneous rocks of various ages. In this paper it will be referred to as "basement".

This stabilized shelf area has been considered as the core of Indonesia, having only a thin cover of rather undisturbed Tertiary sediments. Around this core are the main Tertiary Sedimentary basins.

2. *The Inner Volcanic Arc;* represented by the geanticlines of Sumatra and Java.
3. *The Outer non Volcanic Arc;* represents by the islands offshore west Sumatra. South of Java it is represented by a vague submarine ridge. North of the Sunda Shelf no equivalent island-arc exists, but positive areas are known (Sino-Cambodian Shield).

In between these main major tectonics elements are the Tertiary Sedimentary basins, which are prolific in oil. The onshore portions of these basins have been frequently described (van Bemmelen, 1949, Weeda, 1958, Wennekers, 1958, and Koesoemadinata, 1969) and has been called "ideo-geosynclines" by Umbgrove (1933). The offshore portions of these basinal areas, especially in the Java Sea have shed more light in the nature of mechanism of basin formation, as more modern seismic processing techniques have been employed.

Two major offshore Tertiary basinal areas can be recognized; the Java Sea basinal area, and the South China Sea basinal areas.

THE WESTERN JAVA SEA BASINAL AREA

A major NE - SW trending positive tectonic element separates the western Java Sea basinal (or the Sunda Basinal area) from the eastern Java Sea basinal area. This tectonic element is called the Karimun Jawa Arch, represented by pre-Tertiary outcrops on Karimun Jawa Island group. This positive element appears to be a high area during the entire Tertiary times, supplying sediments into the adjacent basin (Figures 3 and 5).

The nature of the basins has recently been described by Todd and Pulunggono (1971). The controlling factor effecting the basin formation, appears to be a major block-fault system on the rugged pre - Tertiary basement, which here consists of pre-Tertiary metamorphics and igneous rocks. Block-faulting subdivided the area into the Sunda Basin in the west, and the West Java basin in the east, separated by the Seribu Platform, while in the northeast a deep is called the Billiton basin.

In the Sunda and West Java basins a major north - south block-fault system governed erosion, deposition and tectonic growth throughout Tertiary time. This pre-Tertiary system existed as the most influential tectonic element in forming

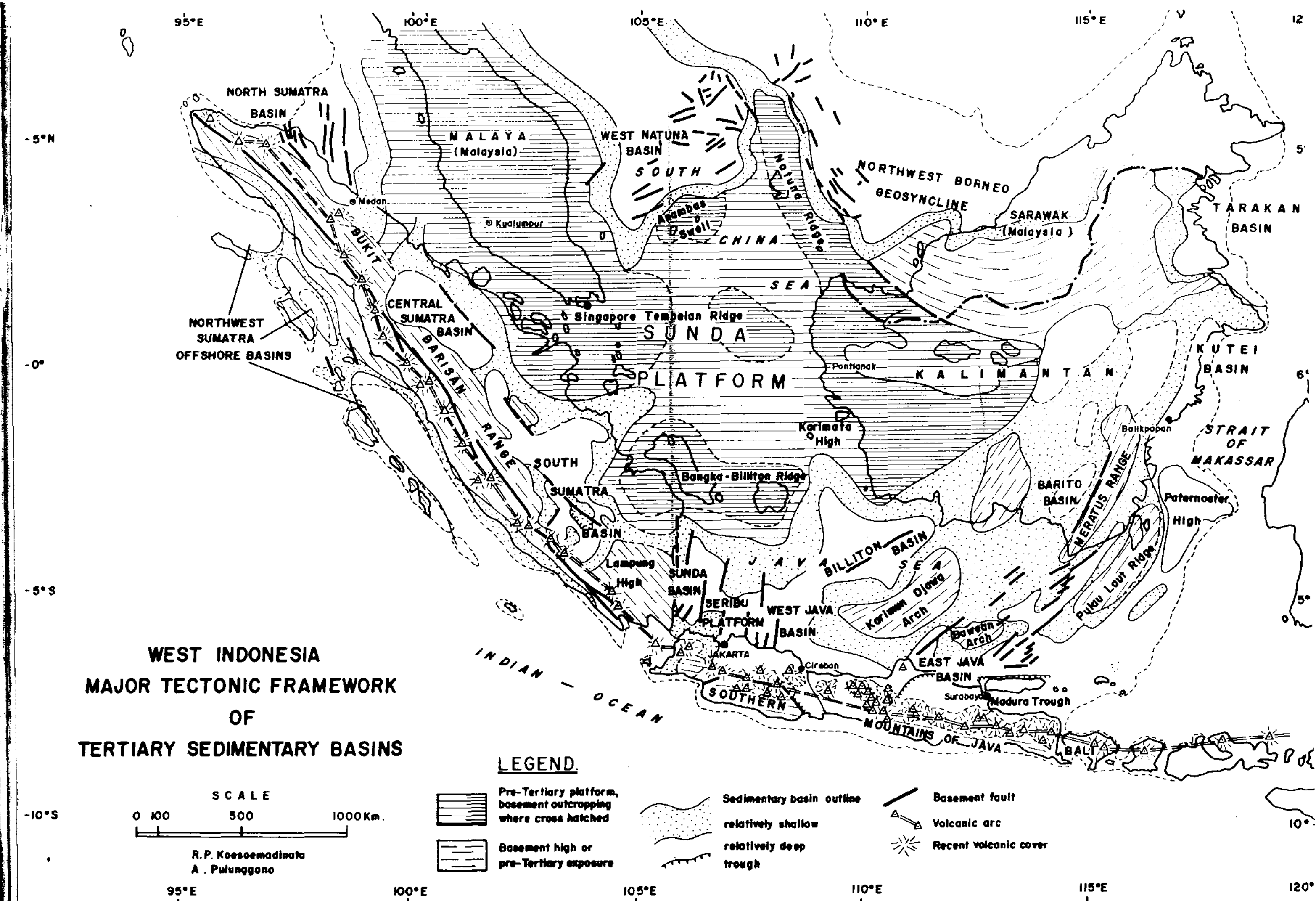

Figure 2: Map of West Indonesia showing major tectonic framework

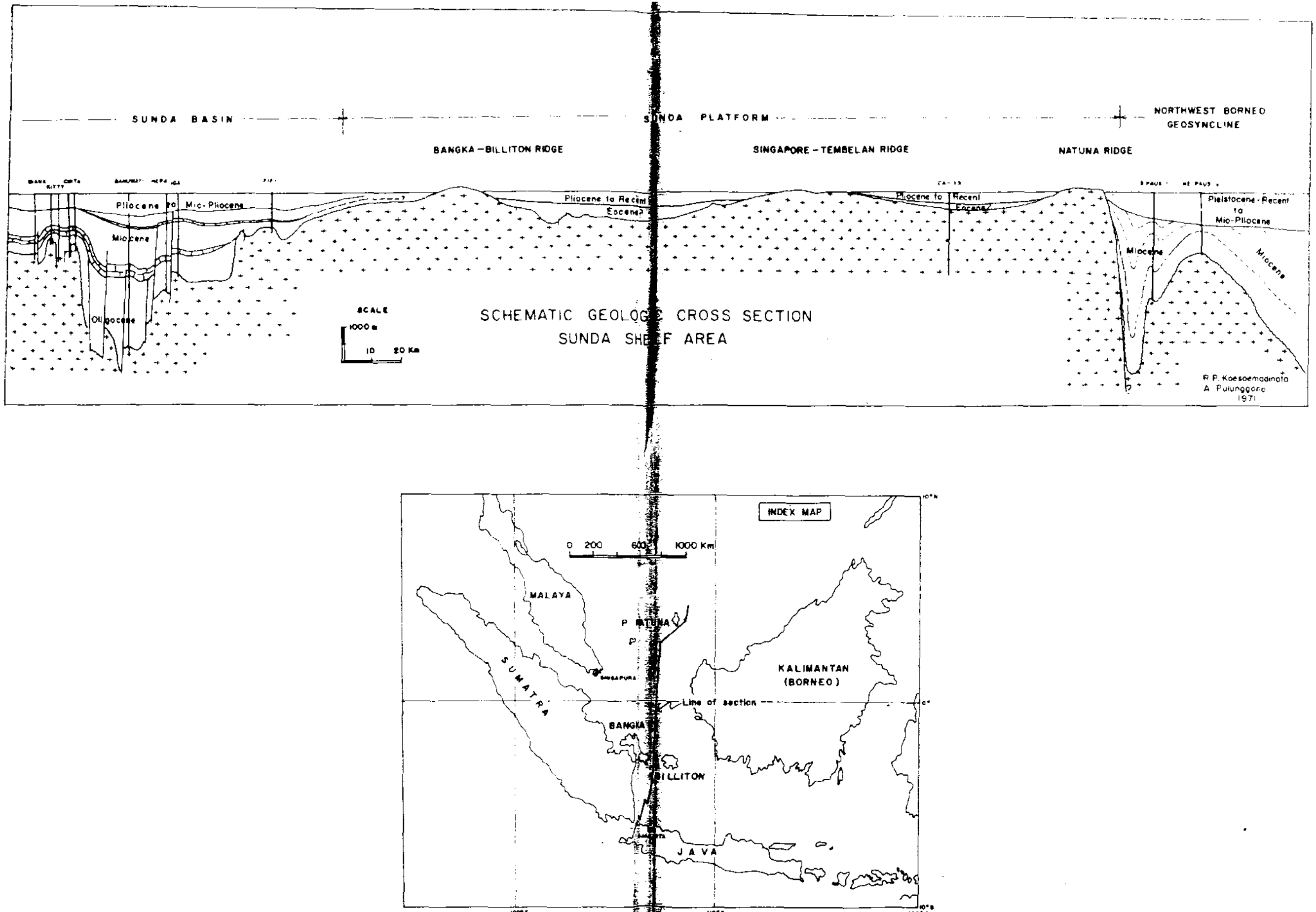

Figure 3: Schematic N-S cross section across the Sunda Shelf

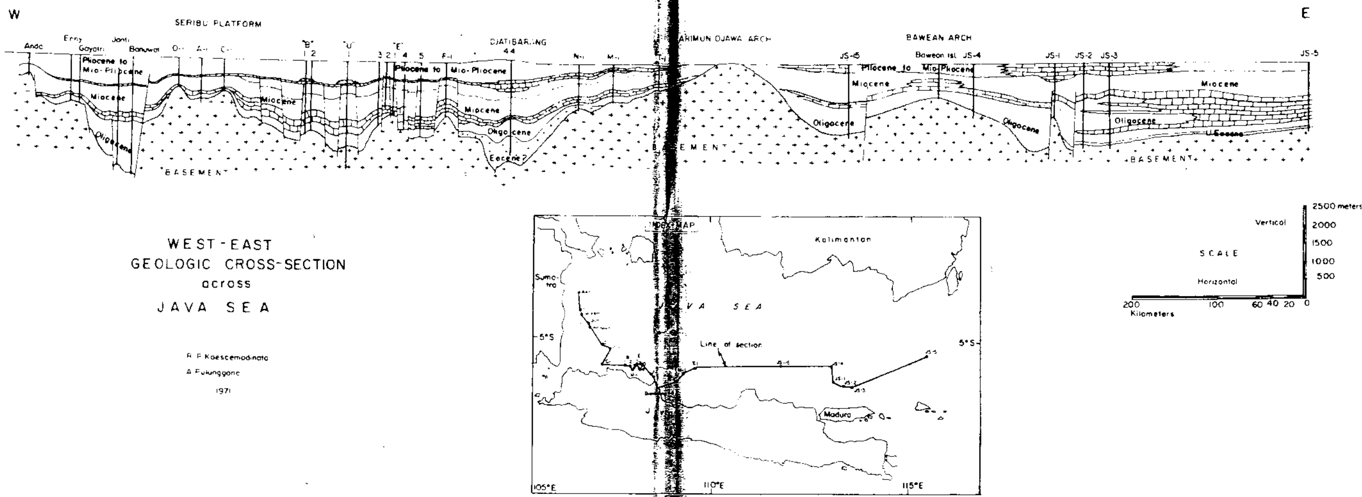

Figure 4: Schematic E-W cross-section across the Java Sea

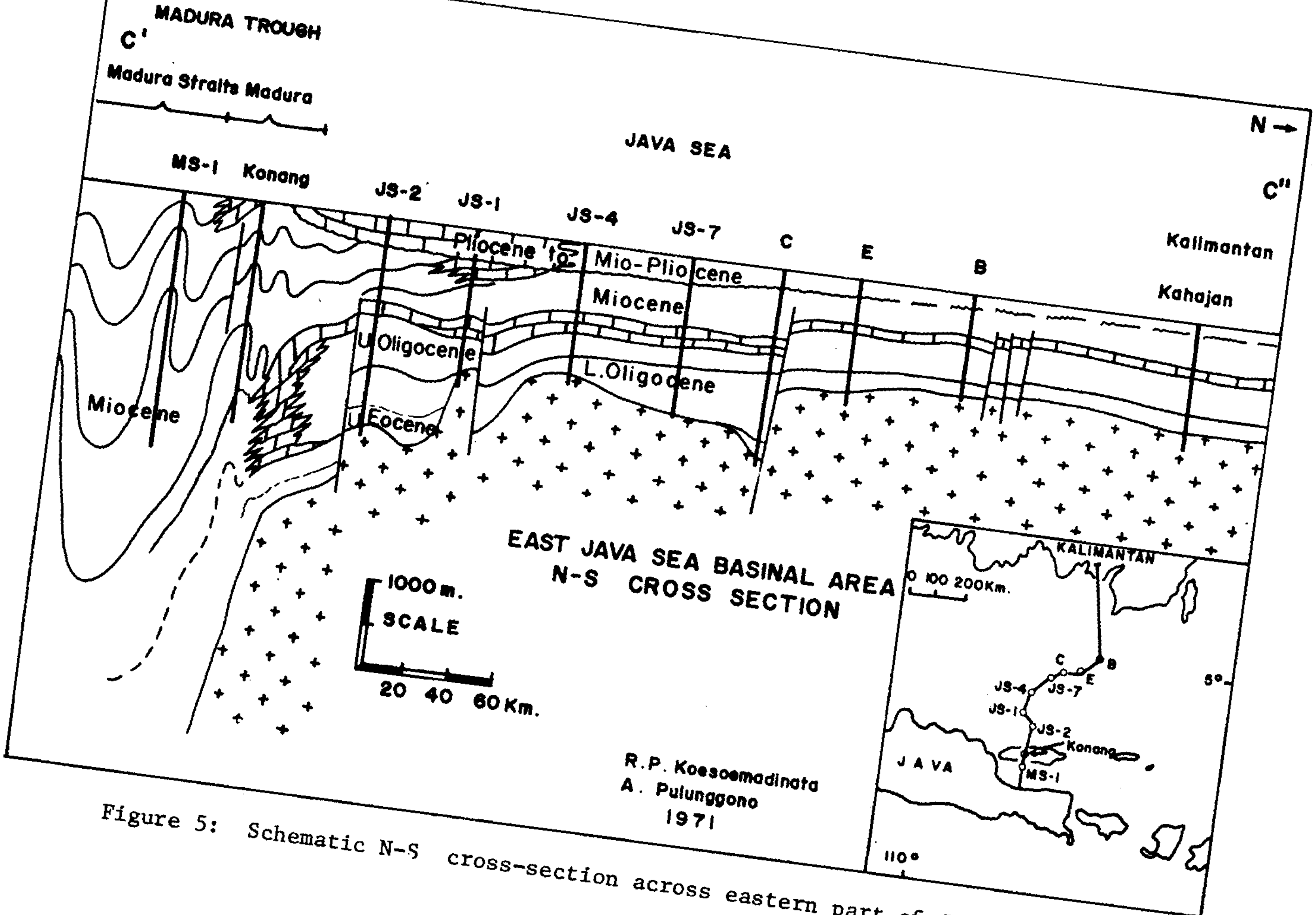

Figure 5: Schematic N-S cross-section across eastern part of Sunda Shelf

the structural grain of these two basin, structural axis are also parallel to the fault system rather than parallel to the Java geanticlinal axis.

As a result of continued Tertiary movements along these fault lines in the Sunda and West Java basin, structural growth and density are unusually high. Structures are often large in areal extent. The greatest Tertiary fault movement occurred in Oligocene and early most Miocene time. At least 1300 meters of displacement took place during this period along the east flank of the Sunda basin. Differential movements along many fault zones continued through Middle Miocene. Many structural features of the Sunda and West Java Basins exhibit structural growth during Tertiary deposition resulting from fault movement. The north-south alignment of the Sumatra coastline suggest a fault zone on the west flank of the Sunda basin adjacent to the Lampung high.

A similar basement block-faulting tectonic control on sedimentation has also been established in South Sumatra by the author (Pulunggono, 1969). Here the major fault trend is NW-SE, parallel to the Semangko Riftzone which has been established as transcurrent fault with recent movements by Katili and Hehuwat (1967). Cross-trends, presumably fault-controlled, is in evidence in early basinal history.

The Billiton basinal deep also appears to be influenced by a northeast southwest fault zone parallel to the Karimun Jawa Arch. This deep basement fault zone is expected to be present also onshore, extending from Jatibarang to Pelabuhan Ratu, called the "Pelabuhan Ratu Trough", where turbidite sedimentation have been observed. Similarly, a NW-SE trend, parallel to the Sumatra trend is also suspected to influence the NW-SE trending-Cirebon-Banyumas Trough, where again turbidite sequences have been observed. It appears that the Java geanticline is dissected by faultzones, and the southern mountain of West Java appears to be an uplifted block.

THE EASTERN JAVA SEA BASINAL AREA

This basinal area is also characterized by block-faulting (Figures 4 and 5). However, the trend is strongly NE-SW, a trend already apparent in the Billiton basin and also expressed by the Karimun Jawa Arch. Other positive areas are the Bawean Arch, and the more less pronounced NE-SW trending Masalembo High. More to the northeast there are several other highs. The basinal deeps are generally much narrower and elongated in the NE-SW direction, as if squeezed in between the broad positive blocks e.g. the basin between Bawean Arch-Karimun Jawa Arch. Indications are that in general the sediments are becoming thicker towards the southeast, i.e. Kangean Island.

Superimposed on this rather old Tertiary basinal configuration is the strong E-W trending Madura Strait Trough, a young Tertiary feature. More than 10.000 feet of Recent to Pliocene sediments is known in the Madura Strait, contrasted to less than 18.000 of section for the entire Tertiary in the eastern Java Sea area. This trough, the extension of the Randublatung zone in east Java, has a more geosynclinal nature. Diapiric structures are known from seismic data. The eastward extension of this deep, is still unknown presently. In general the nature of the Tertiary basin toward the Flores Sea is still known to the authors, as exploration work is just in the beginning stage.

In the southern part of Strait of Makassar (offshore Pulau Laut) basement highs also play a dominating role, i.e. the Paternoster High which has about 1000 meters of Tertiary sediments. This high is presumably a pre-Tertiary basement composed of metamorphic and igneous rocks. Parts of this high have undergone active subareal erosion and contributed clastics to the adjoining basinal areas. The Paternoster High is bounded on the southeast by a down to the NNE-SSW trending major fault or fault zone down stepping toward the southeast. The growth fault nature of basin is clearly shown by the sedimentary sequence in the section 1 (see Figure 6).

Northward, Miocene sediments are known to reach more than 3500 meters in an offshore well east of Balikpapan, while offshore of Tarakan there are indications of marginal highs separating the shelf sediments from the oceanic deep of the Strait of Makassar.

SOUTH CHINA SEA BASINAL AREA

The geology of this area has been discussed by numerous authors recently (Geiger, 1963, Haile, Key and Pimm, 1964, Haile, 1968, 1969, 1970, Issac's, 1962. In this paper, results of recent exploration efforts, especially drilling will briefly be summarized.

Extensive seismic surveys and subsequent drilling has confirmed the general outline of the Sunda Platform in this region. Two main basinal areas can be recognized; the Northwest Borneo Geosyncline in the northeast side, and the west Natuna basin in the northwest. The Northwest Borneo geosyncline has a strong NNW-SSE structural trend. Seismic map of a horizon below a major unconformity shows NNW - SSE trending fault pattern while the basement becomes rapidly deeper toward the northeast. Fold axis are more or less aligned parallel to this fault trend, while dissected by NE - SW normal faults.

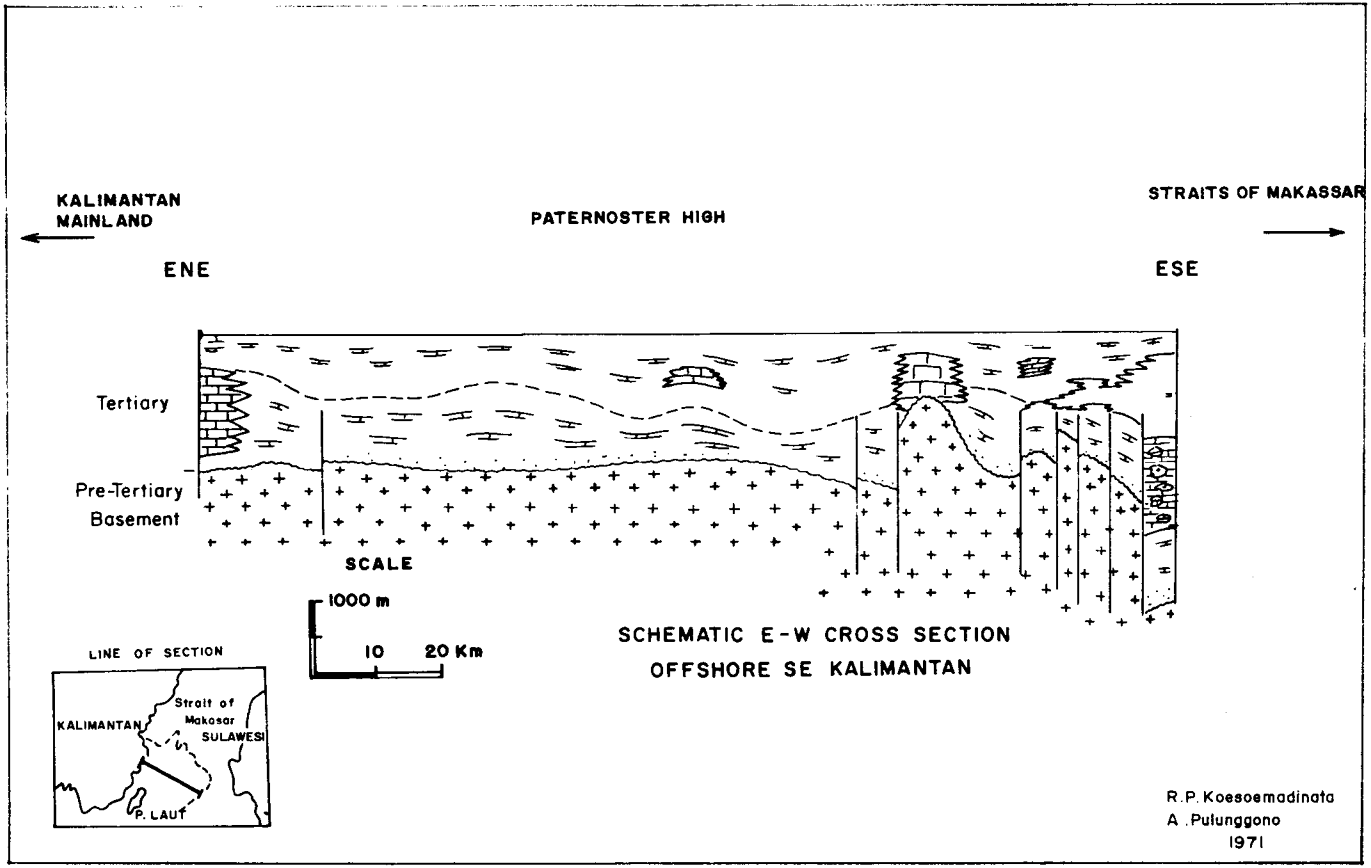

Figure 6: Schematic E-W cross-section across P. Laut, SE Kalimantan

Southwestward onlapping of Late Tertiary sediments toward the platform has been recognized.

This basin apparently controlled by a major fault, hinges on the Natuna Ridge. Basement of the Northwest Borneo Geosyncline consists of low grade metamorphic rock, such as phyllites of Cretaceous-Eocene age. In the platform area the equivalent of this unit is represented by "the Plateau Sandstone" largely unmetamorphosed, although separated by a major unconformity from overlying Tertiary Sediments.

In the west Natuna basin a similar set up has been recognized. The fold-trend along this basinal edge is definitely NE - SW, parallel to the predominating fault trend. NW-SE trending faults are also present. A major fault as shown in Northwest Borneo geosyncline is not present, but step faulting is well expressed. The folds are tightly controlled between these faults. The zone of folding is in between two major synclines. Within this zone diapiric (apparently shale) intrusions are present parallel the above mentioned trend. This NE - SW trend seems to abut toward the Malayan pre-Tertiary trend. Younger Tertiary sediment are onlapping the Sunda platform.

A prominent feature of this northern part of this Sunda Shelf is the socalled Natuna Ridge, which trends NNW - SSE toward Vietnam. Within this arch, faulting is also known parallel to the trend. In the northwesternly extension of this ridge, the NNW - SSE and NE - SW trends are intersecting each other.

NORTHWEST AND NORTHEAST SUMATRA OFFSHORE AREAS

Other offshore Tertiary basins are those situated between the inner volcanic arc and outer non-volcanic arc, off Sumatra's west coast. Recent seismic surveys followed by drilling confirmed the presence of small Tertiary basins, with Eocene sediments at the base. The outline of the basin very much parallel the Sumatra trend, but are subdivided transversely by intervening highs.

The Northeast Sumatra basin is known to continue offshore. It appears that no major fault is to be found as suggested by Weeks, Harbison and Peters (1967) who postulated a NE-SW trending fault on the basis of a submarine topographic feature. The basin opens up toward the NW.

In general it can be said that NW-SW trending faults are common in Sumatra basinal area. These faults are very important in the formation of the basin. In South Sumatra basin such a fault has been described to border a basinal deep (Lematang basin) from a high area (Talang Akar - Pendopo - Limau High) (Pulunggono, 1969). In central Sumatra basin such a NW-

SE trending fault separates the Tapanuli Basin from the Rokan Uplift. In north Sumatra basin such a similar trending fault with a pronounced strike - slip movement has also been recognized.

TERTIARY SEDIMENTATION

Tertiary sedimentation did not begin simultaneously throughout the basins, although the sedimentary sequences are similar. This has been observed by the author in onshore basins (Koesoemadinata, 1969), that Tertiary sedimentation consists of one megacycle, starting with transgression and ending with a regression. Deviation from this sequence is apparent in the Java Sea basinal area, especially toward the east. In the West Natuna basin and the offshore portion of the Northwest Borneo geosyncline, a regressive phase did not take place at the end of cycle.

In the West Java basinal area Eocene transgression took place from the south, but did not reach the offshore basinal areas. Eocene occurrences are restricted to southern part Java. In the East Java Sea Basinal area, however, Eocene also transgressed from the south, east and northeast. In East Kalimantan Eocene sedimentation is firmly established. The transgressive character of Eocene sediments are frequently preceeded by paralic sedimentation or even non-marine fluviatile sedimentation. Eocene transgression is also established in the northwest Sumatra offshore basins as well as northeast Sumatra basinal area. Apparently most of the Sunda shelf area was undergoing subaerial erosion, resulting into rugged topography. Block-faulting may also have been responsible for this topography.

In West Java basin, Eocene is represented by volcanic products, generally restricted to the southern part of Java, but extend also into the Java Sea (i.e. Jatibarang area).

On the Sunda Platform and also in the northern basinal areas, the Eocene marked the end of a Mesozoic sedimentation cycle, characterized by the deposition of a molasse type nonmarine sediments, the "Plateau Sandstone" or the "Natuna Formation" as proposed by Haile (1970).

In the Northwest Borneo geosyncline Cretaceous - Eocene sediments were folded and metamorphosed at the end of Eocene, and subsequently eroded. Here actual Tertiary sedimentation started in Miocene Time.

Blockfaulting control of sedimentation is well exhibited by the offshore basin of Southeast Kalimantan. Thick conglomeratic sediments including limestone, were deposited during the Eocene in the downthrown side (Figure 6).

During Oligocene time clastic sedimentation in topographic lows marked the beginning of the Tertiary cycle in the Sunda basinal area. Main sources of these clastics are from the Bangka-Billiton high at the edge of the Sunda Platform and Karimun Jawa Arch and the Lampung high. Blockfaulting continued to be the controlling factor in basin sedimentation. Rapid subsidence kept pace with clastic infillings of the fault controlled basement lows, resulting into coarse clastics from the adjacent localized fault block.

In the beginning sedimentation took place under non-marine or at least paralic conditions, such as deltaic, paludal or even fluviatile environments. As marine invasion from the south continued northward, marine condition prevailed, while several basement highs continued sticking above sealevel, supplying secondary clastic sediments, while the main source remained the Sunda-land in the north.

In eastern Java Sea basinal area this depositional condition has not been established, but there indications that similar happenings took place. More toward the east, northeast and presumably also to the south sedimentation started almost immediately under marine condition, followed by carbonate deposition. As trangression progressed westward local highs were still sticking above sea level, e.g. Bawean Arch. Basement-fault control of sedimentation is less obvious here. Carbonate deposition is very conspicuous in this basinal area. During Lower Miocene time most basement highs in the entire Java Sea were practically submerged, with the exception of a few highs, such as the Lampung High and Karimun Jawa Arch. This period was marked by an extensive carbonate deposition, including coralline reefs; the latter especially directly on top of the submerged basement highs. This extensive limestone formation can be followed from the Sunda basin to the easternmost part of the Java Sea. It is equivalent to the Berai formation in the Southeast Kalimantan basin, and the Baturaja limestone of South Sumatra. It was presumably during this time that an eastwest trending trough was formed occupying the present Madura-Rembang zone of van Bemmelen (1949). Thick limestone reefs marked the edge of this downwarp.

Marine sedimentation constitued in the whole Java Sea basinal area, while in the basinal deeps shales were deposited. In the western Java Sea basinal areas (Sunda Basinal area) sediment infilling had gradually changed the floor to a relatively flat plane devoid of deep trough and steep basement highs. The maximum transgression, covered also the Lampung High and presumably also the Karimun Jawa Arch. This infilling, associated with uplift to the borderland, caused the sea to reverse into a regressive phase with secondary transgressive incursions.

In the eastern Java Sea basinal area a similar sedimentary succession took place, with the exception that more carbonates were deposited, especially in the southern and eastern portions. Lack of clastic sources is presumably responsible for this type of sedimentation. Less carbonate sedimentation occurred after the extensive Lower Miocene limestone deposition. Detrital clastics were even deposited from high areas, such as the Karimun Jawa Arch. However, at this time only very few basement highs remained above sea level. Isolated reefs occurred along the present northern coastal line of Madura.

The regressive phase in Upper Mid - Miocene is more pronounced here being represented by folding and uplift, tilting the whole region gently toward the south, followed by erosion (Figure 4). In the East Java - Madura area the E-W trending trough shifted toward the present Strait of Madura (Randublatung zone of van Bemmelen, 1949). This orogenic phase is not everywhere represented by folding, uplift and emergence. In the western part of East Java basinal area (Cepu area) this phase is represented by a regression and deposition of detrital clastics (Ngrayong sand), followed by a second transgression. In the Madura Strait Trough (including Randublatung zone) downwarping continued, resulting into thick deposition.

The second transgression during Mio-Pliocene time is more pronounced in the eastern Java Sea area. The southward tilted pre-Upper Miocene strata is truncated and covered by recifal deposit, which is rather extensively distributed (Figure 4). The area apparently became a shallow shelf.

In the southeast Kalimantan offshore area (Pulau Laut) the depositional sequence is similar to that of the eastern portion of the eastern Java Sea area, where carbonate deposition predominated (Figure 6).

The eastern Kalimantan offshore area has a similar depositional history as onshore (Mahakam Basin). Toward the end of Tertiary thick deposition of detrital clastics took place in a typical regressive phase. The pre-Tertiary basement has not been reached here.

The offshore portion of the northeast Sumatra basin shows similar deposition sequences as of offshore portion. The basement-fault, however, appears to have controlled deposition also.

Sedimentation history of the offshore basin west of Sumatra appears to be similar. The sequence begin in Eocene time, as is known from the outcrop sections in the neighbouring island. Numerous unconformities have been found, the Oligocene especially is missing. Environments of deposition are generally shallow marine, and Tertiary reefs have been encountered. Although volcanic material forms a considerable part of the clastics, no characteristics of eugeosynclinal nature has been recognized.

In the West Natuna basin, sedimentation sequence is different. The beginning of Tertiary sedimentation is not known, as indeterminate (non - Marine) sediments from the base of sequence. Palynological analyses suggest an Oligocene age. It is not until Upper Miocene that marine sediments have been identified. NE-SW trending step-faulting with the down thrown side on the NW appears to influence sedimentation (growth fault). Shale diapiric intensions are apparently associated with these phenomena.

In the Northwest Borneo basin (geosyncline), the pronounced NNW - SSE trending fault is influential for sedimentation. The Tertiary cycle of sedimentation began in Lower Miocene time. Phyllite forms the basement which has been determined by K-Ar age as Oligocene age. Sedimentation started in shallow marine environment but immediatelly followed by deep to moderately deep marine condition, until Quarternary. However, limestones intercalations are also known in the sequence.

In this area folding took place in Pliopleistocene time. Folding is presumably entirely due to basement faulting, as starta occurring away from faults are flat lying. Pleistocene occurs unconformably on top of folded Pliocene to Miocene sediments.

EAST INDONESIA

Not much is at present known, as data are still being collected, and being studied. Marine geophysical surveys and drilling are in progress. Numerous offshore drilling locations are scheduled for several years to come.

However, recent seismic surveys followed by drilling confirmed the extension of the Salawati and Bintuni basins, separated from each other by the Ayamaru Platform (Vischer and Hermes, 1962). Fault - control of basin mechanism is convincing. The Sorong fault-zone-swing toward SW near Salawati island, becoming a major dipslip fault, bordering the Salawati basin on the NW (see Figure 7).

Pre-Tertiary sedimentary basins are aslo indicated NW of the Arafura platform (Sahul Shelf).

CONCLUSION

Recent extensive marine seismic investigations and subsequent drilling have contributed considerably to the geology of Indonesia. They have considerably changed our concepts of geotectonics and sedimentation history of the region as well as on basin mechanism.

Basement block faulting appears to have broken up the Sunda Shelf, which was consolidated toward the end of Mesozoic time. Three sets of major fault directions appear to dissect the pre-Tertiary landmass, NW-SE in western part (particularly in Sumatra) and the northeast edge of Sunda Shelf, a NE-SW particularly in eastern Java Sea and east Kalimantan (and NW edge of Sunda Shelf as well as NW Borneo), and a N-S set, especially developed in West Java Sea basinal area (Sunda and West Java basins).

The first two sets may have originated as strike - slip faults, but considerable differential vertical movements must also have taken place, resulting into several basinal subsidence and intervening highs. The N - S trending faults of the Sunda basinal area shows differential vertical movement in a "piano-keyboard" fashion.

An E-W trending fault set is also present, but particularly well developed is East Java, responsible for the trough-like subsidence of the Randublatung-Madura Strait zone.

This fault system apparently left a stable platform untouched, the Sunda platform (or Sunda Shelf proper), which during the entire Tertiary times remains stable and provide clastics sediments. However, Katili (1967) recognized the present system with the same direction as mentioned above.

Fault movements appear to be continuous from the beginning of the basinal subsidence, and controlled strongly sedimentation (growth-faults). Less differential movements took place in younger Tertiary, as the sedimentary strata of this age are generally not cut through, but folding is apparently localized by these fault trends. Uplifted fault-blocks localized clastic sedimentation, while carbonate deposition took place away from basement highs. While less is known from the northern part of Sunda Shelf, faulting apparently also plays a role in sedimentation history as well as folding.

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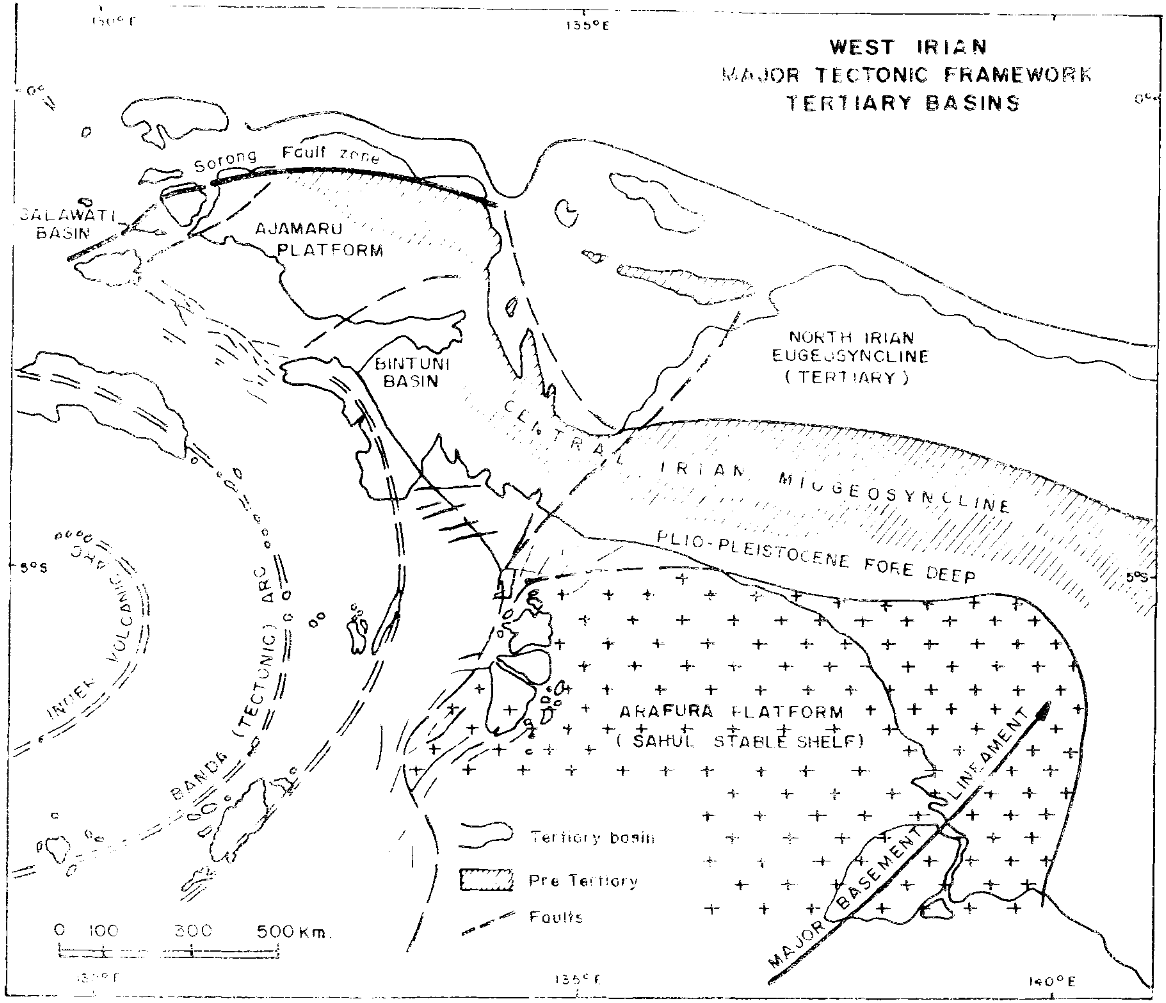

Figure 7: Major Tectonic Frame-work, Sahul Shelf-Irian

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