INDONESIAN TERTIARY SEDIMENTARY BASIN

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ABSTRACT

Since 1980 the number of Indonesian Sedimentary Basin which is officially announced by the government are 60 basins, but informally the variation in the range of less than 60 up to around 66 basins. Based on stratigraphic and tectonics conditions of some areas there are overlapping layers between Tertiary Sedimentary and Pre Tertiary Basin.

In general the definition of a sedimentary basin is a region, part of the earth's crust where sedimentary strata have been deposited in a relatively much greater thickness than its surrounding area. The nomenclature for basin is referred more to basinal areas. Based on sedimentary basin classification there are: type of plate where basin exists, basin position in the plate margin, type of plate interaction, time development of basin and basins fill with respect to tectonic and shape of the basin.

The updating classification using new technology and knowledge of the basin, can also update previous knowledge because of the limitation of the data and the lack of new concept when the report was published.

63 Tertiary Sedimentary Basins (16 producing basin of oil and gas, 8 drilled basin with discovery, 15 drilled basin with has no discovery yet and 24 basin which has not been drilled yet) could be used as a basic data for development of science and technology, to support government policy and investor, to improve and accelerate oil and gas exploration and production in Indonesia.

Key words: New Version, Indonesian Tertiary Sedimentary, Basin.

I. INTRODUCTION

The Indonesian Tertiary Basin as the basic data for exploration activities needs to be updated using new data and new science and technology approach. For the analyses Indonesian Sedimentary Basin map need to be prepared first. The expected outputs will be useful to develop the strategic and to support the government policies and to give benefit for investment in Indonesia.

Map and report of New Version of Indonesian Tertiary Sedimentary Basin could be used as a basic data and information for the development of science and technology, alternative solution to support government policy and investor, to improve and accelerate oil and gas upstream - downstream activities.

II. METODOLOGY

The metodology used in this approach started with data inventory, analysis of secondary data, discussions and compilations of the results from early researchers. The process of map compilations is carried out using Geographical Information System (GIS) Technology and enriched by literature study, gravity data analyses, sedimentary thickness and age analysis, type of continent and oceanic crust and hydrocarbon potential data. GIS builds on geographic science by providing an information system for organizing managing and integrating complex scientific data, for making this data accesible to scientists, decision maker, investors and the public.

For compilation, several Indonesian Sedimentary map are overlaid; i.e., Sedimentary Basin (Hamilton 1974), Sedimentary Basin Map (IAGI, 1980), Sedimentary Basin Map (PERTAMINA - BEICIP, 1985) and Indonesian Sedimentary Basin Map (Marine Geological Institute, 2007) (Figure 1).

III. BASIN CLASSIFICATION

General definition of a sedimentary basin is a region, part of the mantle where the sedimentary layers are placed widely and thicker from the surrounding areas. The nomenclature for basin is referred more to basinal areas. Based on sedimentary basin classification there are: type of plate where basin exists, basin position in the plate margin, type of plate interaction, time development of the basin and basins fill with respect to tectonic and shape of the basin.

Sedimentary basins are the subsiding areas where sediments accumulate to form stratigraphic successions. The tectonic setting is the premier criterion to distinguish different types of sedimentary basins. Several basin classification based on plate-tectonics have been proposed, as active margin and formation of the basins (Figure 2).

IV. UPDATING OF INDONESIAN TERTIARY SEDIMENTARY BASIN

The updating classification has been done using new technology and new knowledge of the basin, the updating of previous knowledge is possible because of the limitation of the data and the lack of new concept when the report was published, this is the case of the basin in Java, other example Pembuang formerly was considered as a basin but now it is changed into a sub basin. Other promising case is that the change of status of several basins such as Banggai and Bone from exploratory basin to producing basin.

To compile Indonesian Tertiary Sedimentary Basin Map, we have conducted some map compilation. The major map as the base is a Map of Sedimentary Basin of the Indonesian Region (Hamilton, 1974) and other maps. In order to accommodate tectonic analysis

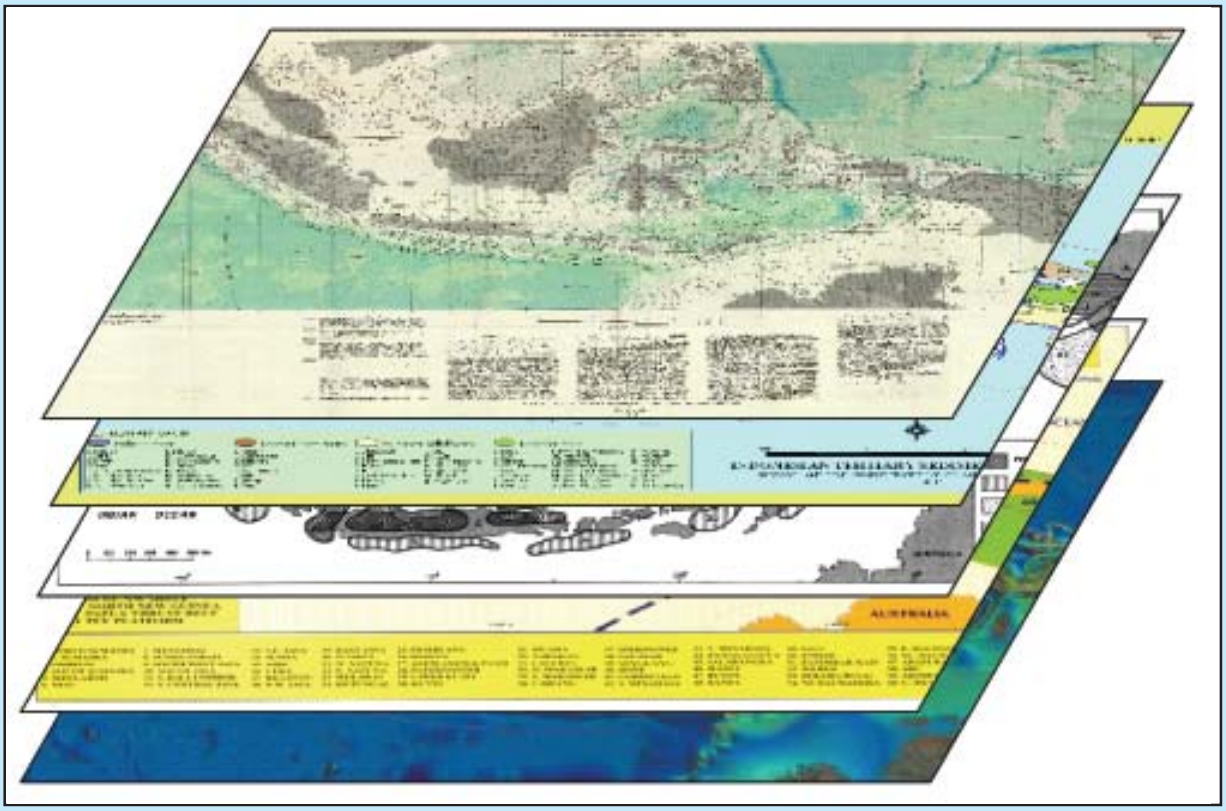

Figure 1
Map Overlay and Comparative Analysis

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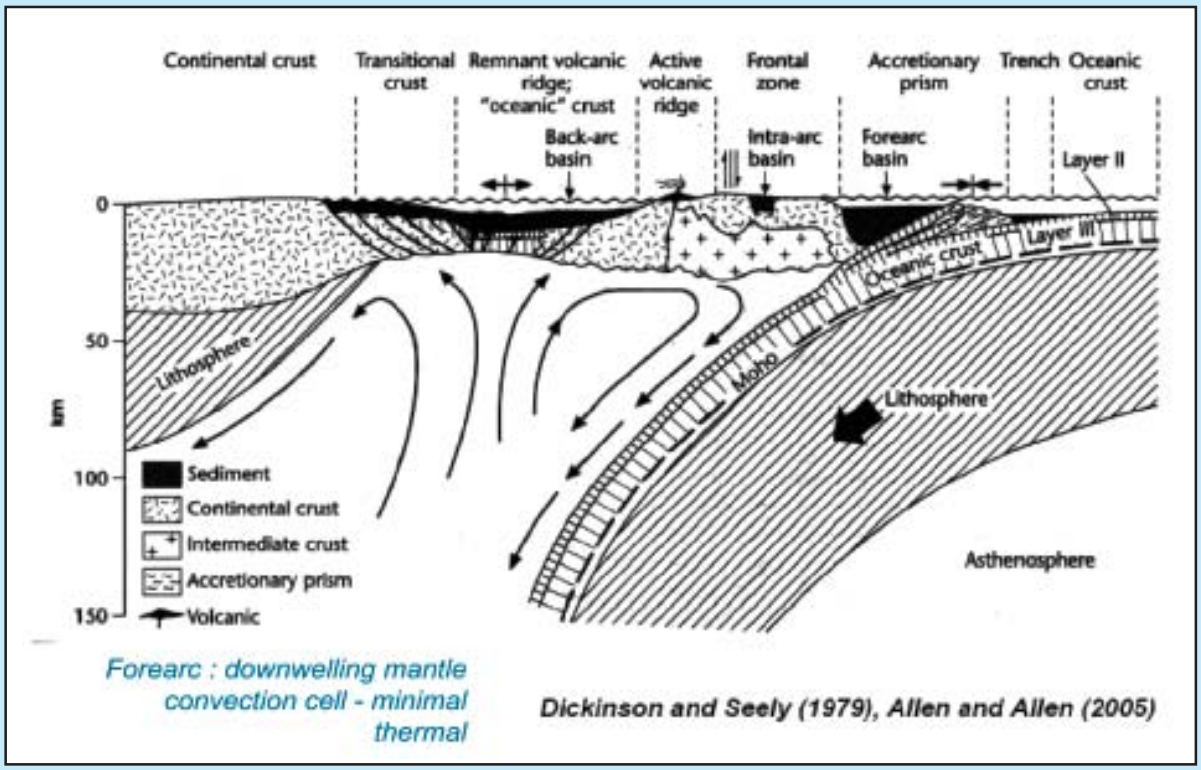

Figure 2
Active Margin and Formation of The Basins
(Allen 2005 vide Awang H.Satyana, 2008)

and the position of each basin, the compilation is compared with shelf position, arc and or magma/volcano belt in Indonesia.

According to last basin data of Sedimentary Map (Directorate General of Oil and Gas/ Ditjend MIGAS, BP MIGAS and Marine Geological Institute (2007) there are 60 basins ; producing basin (16), basin with discovery/non producing (8), drilled basin/no discovery (14), undrilled basin (22).

If one want to compare our analysis with the previous reports there is an increase of the 5 new basins and 1 basin as a part of Barito Basin, and Arafura as Pre-Tertiary Basin. Result of the analysis comes out that the amount Indonesian Tertiary basin is around 63 basins. There are 16 producing basin, 8 drilled basin with discovery, 15 drilled basin with has not discovery yet and 24 basin which have not been drilled.

V. SEDIMENTARY BASIN ANALYSIS

A sedimentary basin is an area of gently folded centripetally dipping strata. It generally covers tens of thousand of square km but their size are not diagnostic. Sedimentary basins are of many types ranging from small alluvial intermontane valley to vast mountain ranges of contorted sediment, km thick. Basins are of three types : topographic, structural and sedimentary. (Selley, R.C., 1988)

A. *Ombilin Basin*

Ombilin basin as an intra mountain basin in West Sumatra whose sediment thickness is about 4,600.00 m. (LEMIGAS, Sulistya Hastuti et al, 1994), it consists of Pre-Tertiary and Tertiary rocks. Tertiary Formations: Brani Formation, Sangkarewang, Sawahlunto, Sawahtambang and Ombilin Formation. Especially Sangkarewang Formation is very interesting because the sediment thickness is about 900 metres (Koesoemadinata and Matasak, 1981).

B. *Java Sedimentary Basin*

Java Tertiary Sedimentary Basin is made up of self basin which is similar to for example Bogor to Cimandiri existence in West Java South arch, North

Serayu basin in Central Java and Kendeng basin between Situbondo-Jember. The existence of the basins in Java mentioned as Intra Arc Basin. It can be explained by Java Island tectonic theory with the appearance of micro continent in East Java since Middle Eosen until the basin has formed in Middle Oligosen (C.Prasetyadi, 2007, Figure 3).

C. *Tectonic and Sedimentation of Pembuang*

Based on aero-gravity measurement in part of South Pembuang basin there is an indication of 3000 m Tertiary sediment thickness (Carson, 1987 vide Sriwijaya, 2004) overlying the crystallin bedrock. However, by studying the distribution of the density, the sediment thickness is as thick as what is represented by Late Cretaceous rock. The Bedrock morphology shows high and low existence though its dimension is small (Figure 4). Lowers area of east Central Borneo Province is estimated to take possession of transition area up to Barito basin. And the existence of Barito basin marked by downhill change of Bouguer anomaly drastically (LEMIGAS, Sriwijaya, 2004).

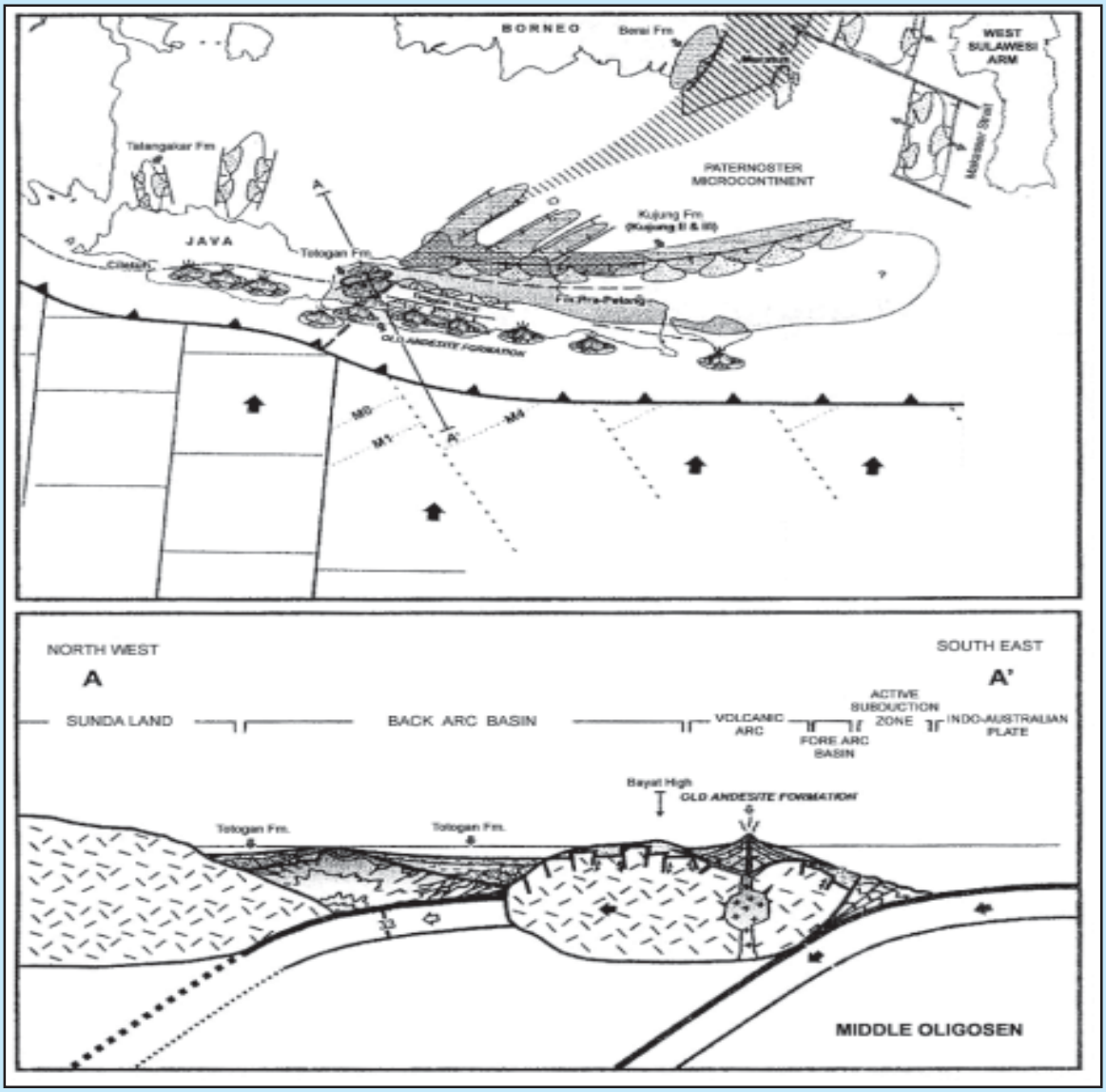

Figure 3
Schematic Reconstruction of Java Middle Oligosen tectonic development
(C.Prasetyadi, 2007)

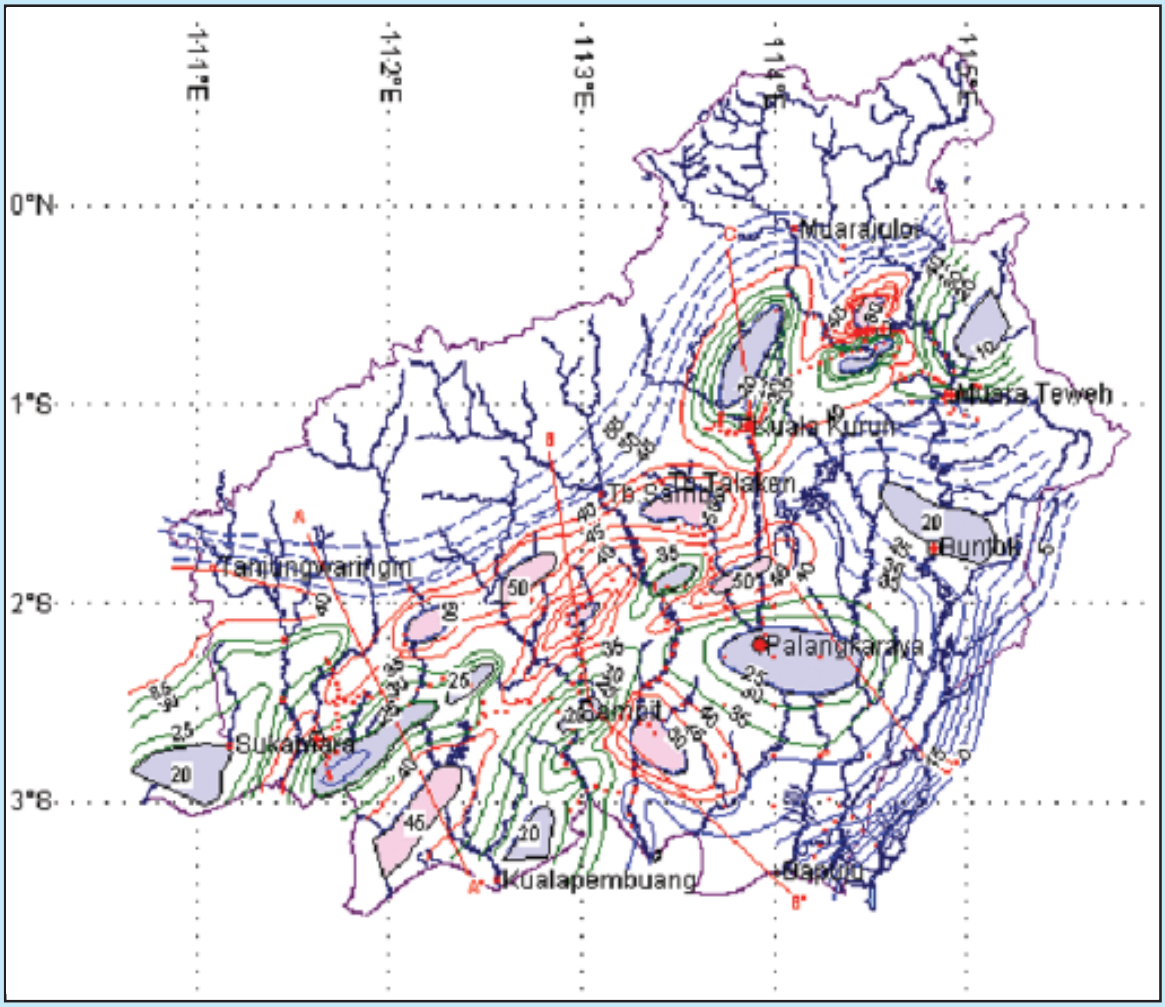

Figure 4
Bouguer Anomaly Distribution Map of Pembuang Area

Result of the Analysis of Sedimentation in Pembuang area:

a. Pembuang rock is more predominated by notching of structure intracratonic basin while in shares of north-north east more aim to shelf edge.

b. At Tertiary Sub-Basin of Pembuang in general still in the form of high, so that is not met the Tertiary sediment. The sedimentation of Sub-Basin in Pembuang only taken place at Quaternary in the form of sediment land.

c. Sub - Basin of Pembuang and Barito Basin was assumed as part of Quaternary period. Be one while at thereafter epoch (Quaternary), only differentiated by change of bedrock elevation.

D. *Arafura Pre Tertiary Basin*

The Arafura Sea area is a continental shelf platform part of Australian-Irian Continent which belongs to Gondwana lithosphere plate, an offshore extension of the Australian continent. The area is bordered by a Tertiary collision in the north, a zone between the Australian Craton and the northern Irian Jaya Island arc, while to the south is a stable Australian Craton. Toward the east lies a stable continental shelf of Australia, while to the west is Aru trough.

Tectonically, Arafura Sea is part of north western portion of Australian continental passive margin, which was rifted since Paleozoic. The rifted margin indicated by a series of grabens associated extension within the region such as Goulburn, Calder, Malita

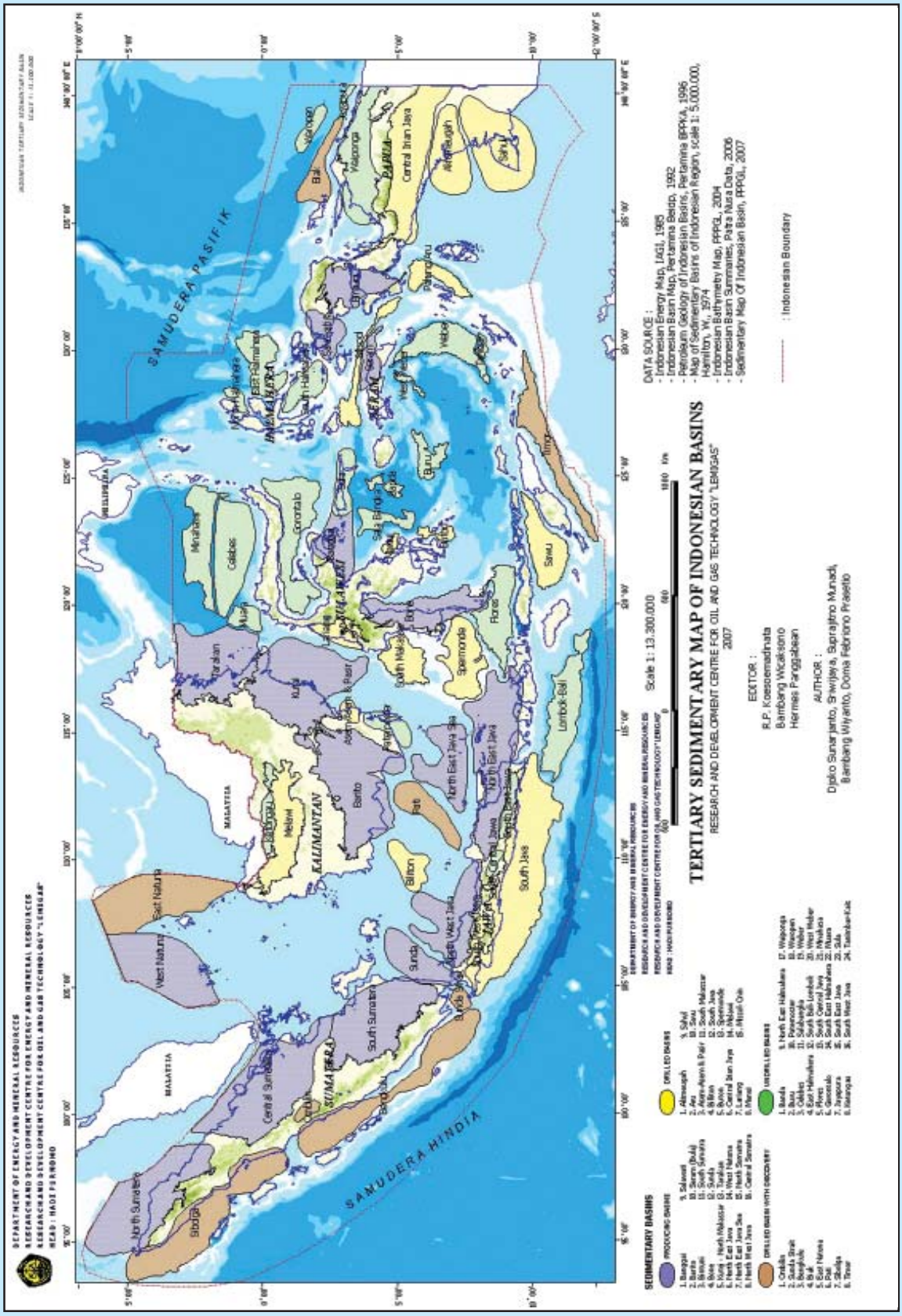

Figure 5
Indonesian Tertiary Sedimentary Basin Map (LEMIGAS, 2007)

Table 1
Basin type and status (2007)

No		Basin	Basins Type	Status
1	1	Akimeugah	Foreland-Foredeep	Drilled Basin
2	2	Aru	Foreland-Foredeep	Drilled Basin
3	3	Asem-Asem dan Pasir	Foreland - Foredeep	Drilled Basin with discovery
4	1	Bengkulu	Fore-Arc	Drilled Basin with discovery
5	4	Biliton	Intracratonic	Drilled Basin with discovery
6	1	Barito	Foreland - Foredeep-Platform	Producing basin
7	2	Bone	Suture Arc	Producing basin
8	3	Bintuni	Foreland-Foredeep	Producing basin
9	4	Banggai	Foreland-Platform - Thrust Fold Belt	Producing basin
10	5	Buton	Foreland-Platform - Thrust Fold Belt	Drilled Basin
11	1	Buru	Suspended	Undrilled Basin
12	2	Banda	Oceanic and Remnant Oceanic	Undrilled Basin
13	2	Biak	Suture Arc	Drilled Basin with discovery
14	5	Central Sumatera (Sumatera Tengah)	Back-Arc	Producing basin
15	3	Celebes	Oceanic and Remnant Oceanic	Undrilled Basin
16	6	Central Irian Jaya (Irian Jaya Tengah)	Thrust Fold Belt	Drilled Basin
17	4	East Halmahera (Halmahera Timur)	Island Arc	Undrilled Basin
18	5	Flores	Back-Arc	Undrilled Basin
19	6	Gorontalo	Suture Arc	Undrilled Basin
20	7	Jayapura	Suture Arc	Undrilled Basin
21	8	Ketungau	Foreland - Foredeep	Undrilled Basin
22	6	Kutei	Abborted Rift	Producing basin
23	7	Lariang	Abborted Rift	Drilled Basin
24	8	Misool-Onin	Foreland-Foredeep	Drilled Basin
25	9	Manui	Foreland-Platform	Drilled Basin
26	9	Minahasa	Oceanic Trench	Undrilled Basin
27	10	Muara	Pull-Apart	Undrilled Basin
28	10	Melawi	Foreland - Foredeep	Drilled Basin
29	7	North Sumatera (Sumatera Utara)	Back-Arc	Producing basin
30	8	North West Java (Jawa Barat Utara)	Back-Arc	Producing basin
31	9	North East Java (Jawa Timur Utara)	Back-Arc	Producing basin
32	10	West Natuna (Natuna Barat)	Intracratonic	Producing basin
33	3	East Natuna (Natuna Timur)	Passive Margin	Drilled Basin with discovery
34	11	North East Java sea (Laut Jawa Timur Utara)	Back-Arc	Producing basin
35	11	North East Halmahera (Halmahera Timur Laut)	Island Arc	Undrilled Basin
36	4	Ombilin	Intra-Arc	Drilled Basin with discovery
37	12	Paternoster	Foreland - Platform	Undrilled Basin
38	5	Pati	Intracratonic	Drilled Basin with discovery
39	6	Sibolga	Fore-Arc	Drilled Basin with discovery
40	12	South Sumatera (Sumatera Selatan)	Back-Arc	Producing basin
41	13	Sunda	Back-Arc	Producing basin
42	11	South Java (Jawa Selatan)	Fore-Arc	Drilled Basin
43	13	South West Java (Jawa Barat Selatan)	Intra-Arc	Undrilled Basin
44	14	South Central Java (Jawa Tengah Selt)	Intra-Arc	Undrilled Basin
45	15	South East Java (Jawa Timur Selatan)	Intra-Arc	Undrilled Basin
46	12	Spermonde	Abborted Rift	Drilled Basin
47	13	Sawu	Fore-Arc	Drilled Basin
48	14	Sahul	Intracratonic	Drilled Basin
49	16	South Bali-Lombok (Bali - Lombok Selatan)	Fore-Arc	Undrilled Basin
50	14	Salawati	Transform Margin	Producing basin
51	15	South Makasar (Makassar Selatan)	Abborted Rift	Drilled Basin
52	17	Sula	Foreland-Platform - Thrust Fold Belt	Undrilled Basin
53	18	Salabangka	Foreland-Foredeep	Undrilled Basin
54	15	Seram (Bula)	Suspended	Producing basin
55	19	South East Halmahera (Halmahera Tenggara)	Island Arc	Undrilled Basin
56	7	Sunda Strait (Selat Sunda)	Pull-Apart	Drilled Basin with discovery
57	16	Tarakan	Abborted Rift	Producing basin
58	8	Timor	Suspended	Drilled Basin with discovery
59	20	Tanimbar - Kais	Suspended	Undrilled Basin
60	21	Waropen	Suture Arc	Undrilled Basin
61	22	Waiponga	Suture Arc	Undrilled Basin
62	23	West Weber (Weber Barat)	Oceanic and Remnant Oceanic	Undrilled Basin
63	24	Weber	Oceanic and Remnant Oceanic	Undrilled Basin

grabens in NW Australian and ASM Graben in Akimeugah Basin.

Other definition a sedimentary basin is an area of the earth's crust that is underlain by thick sequence of sedimentary rocks. Sedimentary basin form part of the earth's crust or lithosphere, they are generally distinguishable from granitic continental and basaltic oceanic crust by their lower densities and slower seismic velocities (Selley, RC, 1985).

For the purpose of updating Indonesian Tertiary Sedimentary Basin Map, Some map compilation are conducted. The major map are the Map of Sedimentary Basin of The Indonesian Region (Hamilton, 1974) and the other maps. In order to accommodate tectonic analysis the position of each basin is compiled with shelf position, arc and or magma/volcano belt in Indonesia.

Map and analysis of New Version of Indonesian Tertiary Sedimentary Basin could be used as a basic data for the development of science and technology for this purpose, to support the government policy and investor also to improve and accelerate oil and gas exploration and production in Indonesia.

VI. RESULT AND DISCUSSION

The basic concept of other analyses which is used in grouping the basin is based on the following criteria ;

- There is one merging plane for the sediment to be deposited during specific time interval of sedimentation either all or partly.
- A part or all of sediment involves in tectonic activity e. g ; folding, faulting and uplifting.
- Not always the same geomorphological shape happened but also clinoform in shape.
- Layer of sediment in basin margin is getting thinner or pinch out.

Result and re-evaluation and data analysis of basin in entire Indonesia indicate that the basin in Indonesia can increase to an amount of 63 basins (Figure 5 and Table 1), is which 16 are producing, 8 have been drilled basin with discovery, 15 drilled basin but has invention yet and 24 basin have not been drilled. They can be categorized as :

a. Tectonic and stratigraphic basin condition some of basinal area there are Tertiary and Pre Tertiary sedimentary basin. For example Arafura Basin (Pre Tertiary).
b. The changes of exploration basin statue to producing basin (Banggai Basin).
c. Digitally frequent from re-analysis result.

VII. CONCLUSIONS

Compared to the analysis of the previous 60 basins, there is an increase of three additional basins, the case of intra arc basin in part of central Java (between Southern Java basin and NW Java-NE Java). Other example Pembuang formerly was considered as basin but now is a part of Barito Basin. Other promising case is that the change of status of several basins such as Banggai and Bone from exploratory basin to producing basin.

Result, re-evaluation and data analysis of the entire basin in Indonesia Basin indicate that in Indonesia, amount of the basin a 63, the detail is as follows : 16 producing basin, 8 drilled basin with discovery, 15 drilling basin with not yet invention and 24 basin not yet been drilled. Result of this analysis can be used as a reference in considering the government's policy, communities and investors to implement oil and gas exploration and development in Indonesia. Besides, as a basic platform for research and development, regulation and policy are needed to update the number of basin periodically.

Compilation of geographical position of each basin conducted by mapping of the boundary basin pursuant of point square every basin. Point square is intended to facilitate the indentification of early position before it is conducted a location detail later with lines coordinate in the form of latitude and meridian of each Indonesian Tertiary Sedimentary Basin.

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