Indonesian Marine Geology Research Vessels: Their Capacity and Activity

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INTRODUCTION

About two thirds of Indonesian territory is covered by sea, below which there is little-documented and fascinating geological features which require study. Observing and understanding this geology is obviously technically more difficult than for the onshore. Thus, knowledge of the submarine geology relies on research and commercial ships.

The marine geology of Indonesia has been studied since the 18th century. Two French ships called *Boudeuse* and *Etoile*, and led by De Bougainville sailed to collect data in 1768. Since then many other research vessels came and were run by researchers from the UK, Austria, the Netherlands, USA, Germany and Japan. In late 1980s Indonesia bought its own research vessel, *Baruna Jaya 1*, and since then has built its own fleet of research vessels.

The four institutions which run research vessels in Indonesia are:

1. **BPPT** – Badan Pengkasijan dan Penerapan Teknologi or the Agency for the Assessment and Application of Technology. It is a non-departmental government agency under the coordination of the Ministry of Research and Technology, which has the tasks of carrying out government duties in the field of assessment and application of technology. BPPT operates 4 Baruna Jaya vessels. BPPT named their research vessels as Baruna Jaya I, Baruna Jaya II, Baruna Jaya III and Baruna Jaya IV
2. **P3GL** – Pusat Penelitian dan Pengembangan Geologi Kelautan or Marine Geological Institute, under the ministry of Energy and Mineral Resources. This organization has been tasked to carry out research, development, surveys and conduct systematic mapping of the marine geology of Indonesia. P3GL has one Geomarin III research vessel.
3. **LIPI** – Lembaga Ilmu Pengetahuan Indonesia or Indonesian Institute of Sciences. LIPI manages two research vessels: Baruna Jaya VII and Baruna Jaya VIII. The Baruna Jaya VII is a fishery patrol vessel and the Baruna Jaya VIII is one of the most modern research vessels in Indonesia, equipped for biological, geological and oceanographic surveys.
4. **Balitbang KP** – Badan Penelitian dan Pengembangan Kelautan dan Perikanan or Agency for Marine and Fisheries Research and Development of the Ministry of Marine Affairs and Fisheries. This agency operates several research vessels including *KR. Madidihang* and the newest vessel *Bawal Putih III*.

THE RESEARCH VESSELS

BPPT Baruna Jaya (BJ) research fleet comprises the four ships named above (Figure 1). All built by CMN in Cherbourg, France, the first three were constructed in 1989-1990 while the latest was built in 1995. Each of them can carry 11-17 crew and 28 scientists. These ships are about the same in dimension with 60.4 meters in length and 11.6 m in width. The gross weights of *BJ I, II and III* weigh 1184 tonnes and *BJ IV* is slightly heavier with gross weight of 1219 tonnes. Their cruising speeds range from 8 to 10 knots (Table 1).

Each ship has different functions. *BJ II*, for example has 2D seismic acquisition facility, *BJ III* has oceanographic/geological research facility. The seismic processing unit has industrial standard equipment, using Linux-based software such as ProMAX™. *BJ I* has deep sea multipurpose research facility and *BJ IV* has hydrographic, oceanographic and fishing research instruments. BPPT has research instruments which can be added, such as side scan sonar unit, magnetometer, marine resistivity, sample grabber, dredging tool and coring tool.

BJ VII is fishery patrol vessel and *BJ VIII* is a high end research vessel that can conduct geological and geophysical surveys. Both vessels were operated by LIPI. *BJ VIII* was built by PT. PAL in Surabaya, Indonesia.

	Baruna Jaya I	Baruna Jaya II	Baruna Jaya III	Baruna Jaya IV	Baruna Jaya VII	Baruna Jaya VIII	Geomarin I	Geomarine II	Geomarin III	Madidihang	Bawal Putih-3
Operator	BPPT	BPPT	BPPT	BPPT	LIPI	LIPI	P3GL	P3GL	P3GL	Balitbang KP	Balitbang KP
Launch	1989	1989	1989	1989	1998	1998	1990		2008	2010	2013
Origin	France	France	France	France	Indonesia	Norway	Japan	Indonesia	Japan	Spain	Indonesia
Crew	17	11	17	17		23	12	2	22	27	
Scientist	28	28	28	28		30	9	4	29	50	15
Length (m)	60.4	60.4	60.4	60.4	53	48.8	31	5	61.7	50	42
Width (m)	11.6	11.6	11.6	11.6	12	12.5	6.8		12	9.8	8.7
Gross weight (ton)	1184	1184	1184	1219	641	1273	179	1	1300	723	395
Speed (knot)	10	10	8	8		10	9	9	13.5	11	16
Function	Deep sea research	Seismic 2D	Oceanographic + geological	Oceanographic + fisheries research	Fishery research vessel	Wide range biological, geological and oceanographic survey	Shallow water geological and geophysical survey	Coast and river survey	Seismic 2D, gravity-magnetic, sea bottom imaging	Fishery training, oceanographic	Fishery, geology, geophysics, oceanographic

Table 1. *Comparison of the 7 Indonesian marine research vessels under BPPT and P3GL management.*



Figure 1. *Indonesian research vessels under BPPT management are: (a) Baruna Jaya I, (b) Baruna Jaya II, (c) Baruna Jaya III and (d) Baruna Jaya IV. LIPI manage (e) Baruna Jaya VII and (f) Baruna Jaya VIII. Geomarin I (g), Geomarine II (h) and Geomarine III (i) are run by P3GL. Madidihang (j) and the newest Bawal Putih III (k) belong to Balitbang KP.*

P3GL manages 3 vessels called *Geomarin I, Geomarin II and Geomarin III* (Figure 1). *Geomarin I* has been used to complete shallow water mapping in western Indonesia. *Geomarin II* is a small boat which is useful for coastal and river mapping. Recently it was used for river survey on the impact of Sidoarjo mud in Porong River, East Java. P3GL's *Geomarin III* is a modern research vessel, which was completed in Japan and operated in 2008. It replaced previous *Geomarin I and II* vessels. Compared to the Baruna Jayas, *Geomarin III* is slightly bigger. It is 61.7 m long, 12 m wide and its gross weight is 1300 tonnes (Table 1). *Geomarin III* is equipped with modern facilities such as 2D seismic acquisition equipment with 480 channels, onboard seismic processing unit, also multibeam, side scan sonar, and magneto-gravity meter

instrument. It also has sediment coring system and onboard laboratory.

RESEARCH ACTIVITIES

Baruna Jaya vessels were involved in many research activities. The following are examples of their marine geology related projects in the last 5 years:
- Seram: Geological and geophysical 1:500.000 scale mapping in Seram Sea.
- Ternate and Kapuas: Sea bottom profile / bathymetric mapping.
- Makassar Strait: marine resistivity survey.
- Mahakam Delta: abrasion survey for Total EP Indonesié.
- Bangka Island: submarine mineral deposit mapping around the island.
- Natuna Sea: Geophysical and geotechnical survey.
- Tsunami buoy placement, replacement and maintenance.

The research vessels managed by BPPT are up to industrial standards; therefore they were also used in a number of industrial activities. Total Indonesié, ExxonMobil, Elnusa, EMP Kangean and Fugro are examples of petroleum related companies which used the Baruna Jaya vessels.

The Seismic data acquired by Baruna Jaya in frontier areas of Indonesia provide initial regional understanding (Figure 2). Although their coverages are sparse, they gave preliminary view on the geology. Some surveys with potential will be followed by denser seismic with better resolution.

P3GL's *Geomarin III* has also completed a number of significant research projects related to Indonesian marine geology. Figure 3A shows the marine geological map of Indonesia based on Geomarine surveys. The western part of Indonesia has been covered but there are still significant areas to be covered in Eastern Indonesia. Figure 3B shows the map quadrants completed by P3GL so far. The current project aims to complete significant areas in eastern Indonesia by 2019.

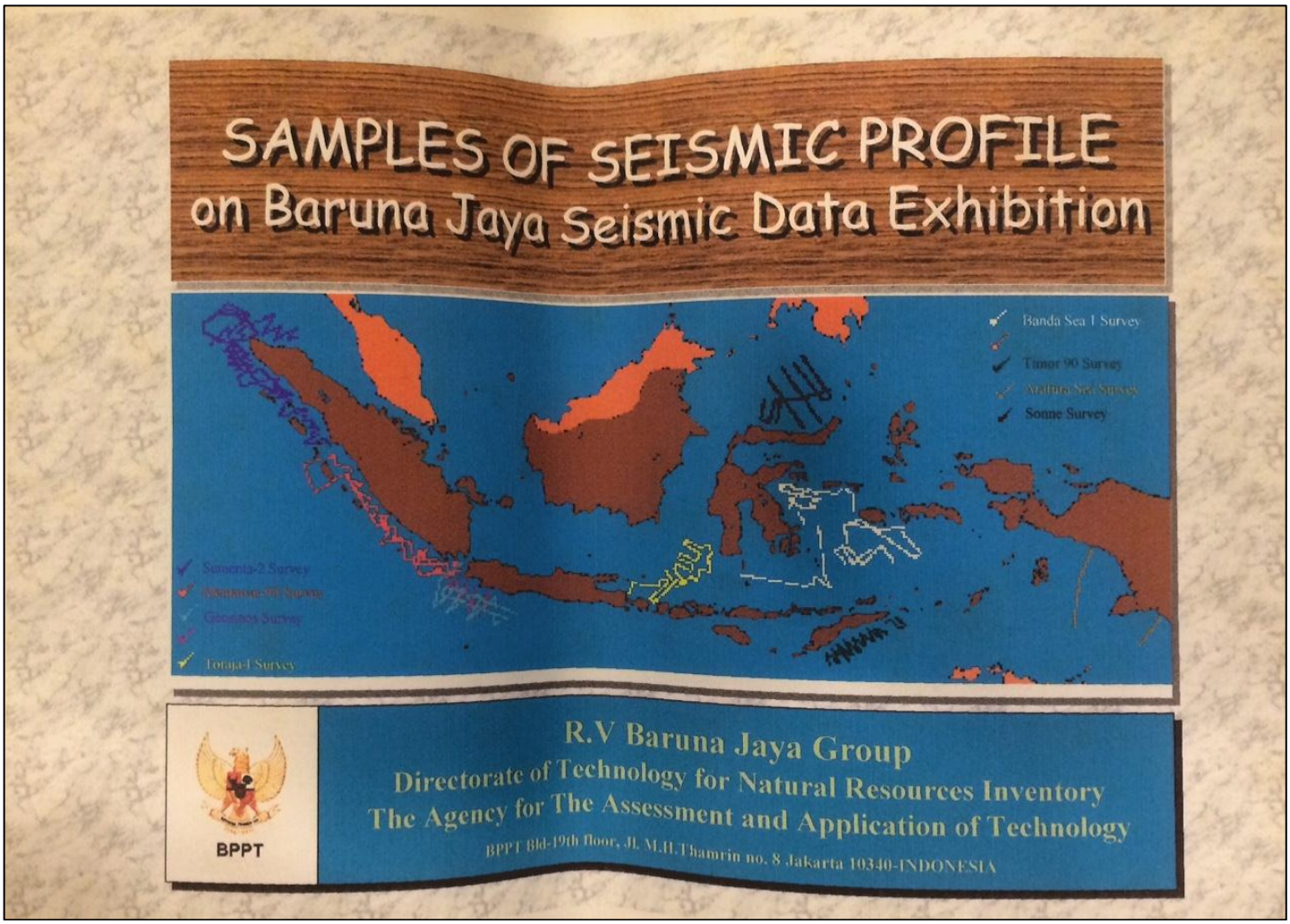


Figure 2. *The cover of Samples of Seismic Profile on Baruna Jaya Seismic Atlas, prepared in 1990's by BPPT. The cover also shows the coverage of Baruna Jaya vessel (source H. Darman).*

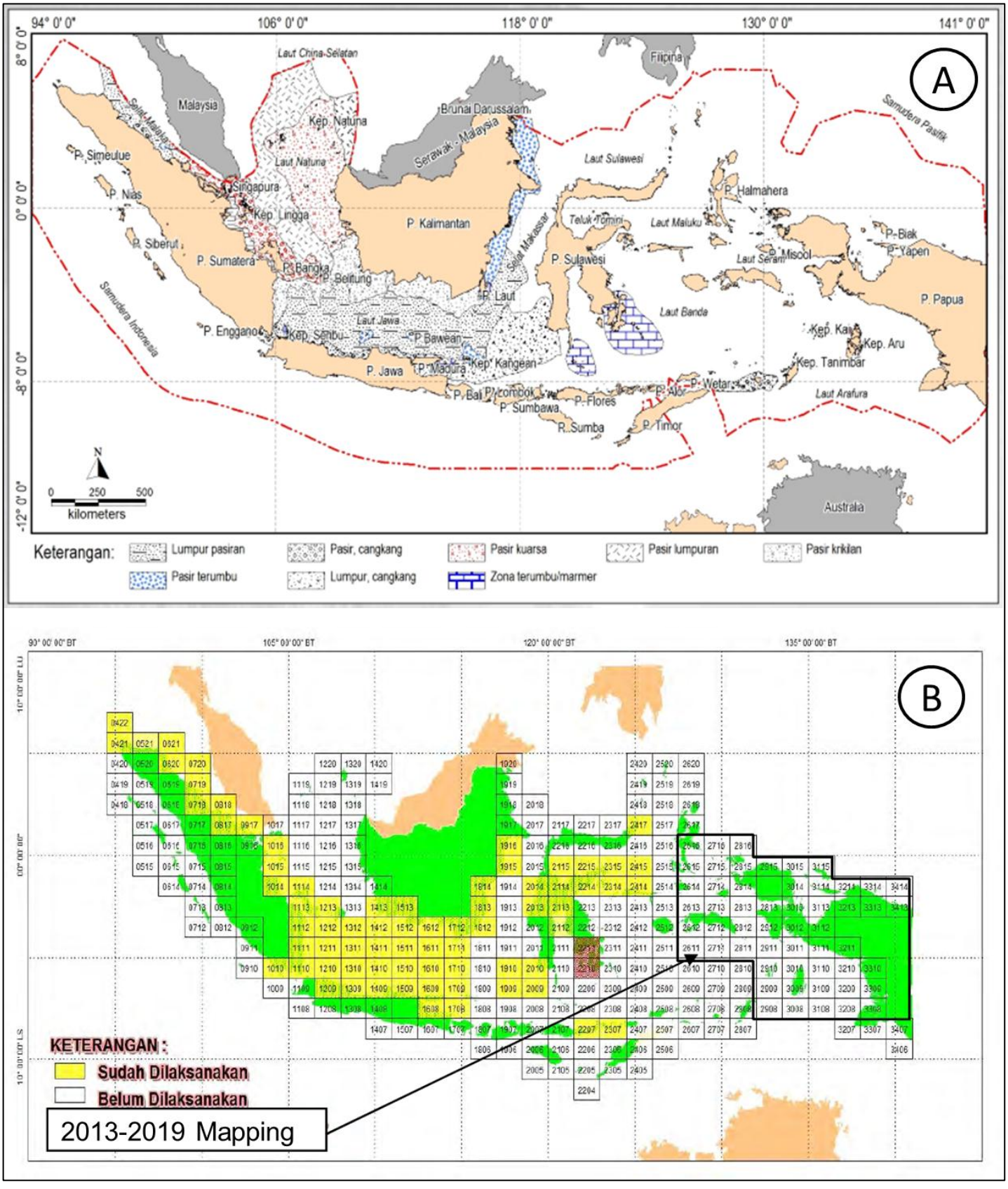


Figure 3. *A) Sea bottom sediment compiled from 1 : 250.000 systematic mapping result of P3GL from 1984 to 2012. The units are defined based on the distribution of sediment texture and composition (Usman, E., 2014).B) Geological and geophysical map quadrant of 1:250.000 scale. Yellow boxes indicated completed quadrant. The area indicated with black outline is the 2013-2019 mapping project area (Arifin, L., 2013).*

CONCLUSION

The vast area of Indonesia needs to be explored. There are still areas with very limited geological understanding, especially remote offshore areas but the five research vessels of Indonesia are insufficient to cover them. Until funds are available to increase the size of this hard-worked fleet, proper and detailed planning in conducting surveys becomes critical for efficient, cost-effective surveying.

REFERENCES

Arifin, L., 2013. Pemetaan Geologi dan Geofisika di Perairan Indonesia. Majalah Mineral dan Energi, Vol. 11, No. 4 – December.

BPPT Baruna Jaya website: http://barunajaya.bppt.go.id/index.php/id.html

Geomarin I-III website: http://www.litbang.esdm.go.id/index.php?option=com_content&view=category&layout=blog&id=83&Itemid=94

Usman, E., 2014. Data Dasar untuk Penyusunan Peta dan Kebijakan Pengelolaan Sumber Daya Mineral Kelautan Indonesia. Majalah Mineral dan Energi, Vol. 12, No. 2 - June

P3GL website: http://www.mgi.esdm.go.id/