Member Country Report of INDONESIA

Submitted by

Indonesian Delegation / Geological Agency

(For Agenda Item 3)
1. OUTREACH

The geology related programmes and activities during the period of 1 July 2017 – 30 June 2018 are classified into seven groups, i.e.: Geo-information, Environmental Geology, Geohazards, Groundwater, Marine Geology, Minerals, and Energy (in particular Fossil Energy).

GEO-INFORMATION PROGRAMME

1.1. Summary

During the period of July 2017 to June 2018, the activities related to geo-information programme are:

- updating some geology-related maps in scale of 1:100,000 and 1:50,000, following the One Map Policy by the ruling government, in order to support acceleration of Economic Policy,
- continuing the CCOP Geo-information Sharing Infrastructure for East Asia and Southeast Asia (GSI) Project,
- developing of Multiplatform Applications for Geohazard Mitigation and Assessment,
- developing Geological Database of Indonesia.

1.2. Annual Review of Individual Technical Activities

- The Geological Agency of Indonesia continues to support One Map Policy through 10 thematic GIS map among 85 totally until 2019. The One Map Policy was originally intended to achieve a good spatial planning governance, a geospatial information for the Acceleration and Expansion of Indonesia Economic Development. The 10 thematic maps consist of geological map, geo-resources (mineral, coal, geothermal) maps, hydrogeological map, karst map, and geo-hazards (volcanoes, earthquakes, tsunamis, landslides) maps. Updating map carried out for Sumatera, Sulawesi, Bali and Nusa Tenggara based on the new edition of Indonesian Topographic Map (Peta Rupabumi Indonesia) on 2017, and also Jawa, Maluku and Papua on 2018.
Continuing the CCOP Geo-information Sharing Infrastructure for East and Southeast Asia (GSi) Annual Meeting that was held on 16-19 October 2017 at Cebu, Philippines.

Since 2017, Geological Agency of Indonesia has been developing a Multiplatform Application for Geohazard Mitigation and Assessment in Indonesia, called as MAGMA Indonesia version 2, which was firstly developed in 2015. MAGMA Indonesia is the first multiplatform (Web & Mobile) application in the world, containing integrated information and recommendation on geological disaster (volcanic eruptions, earthquakes, tsunamis, and landslides) events in Indonesia. The application is widely used by public.
• Geological Agency of Indonesia as data provider, since 2017 has been developing the Geological Database of Indonesia. Considering the large number of data and rapid increase the demands of the geological data, the database system is continuously developed and updated.

• The Geological Agency has produced several scientific national and international publications, including
  1. Indonesian Journal on Geoscience (IJoG), an international journal, SCOPUS indexes, publish 3 issues per year;
  2. Bulletin of Geological Resources, an national journal, publish 3 issues per year;
  3. Journal of Geology and Mineral Resources, an national journal, publish 4 issues per year;
  4. Center for Geological Survey (CGS) - Geological Agency (GA) has interpreted the satellite image covering whole area of Indonesia to produce systematic geological maps. This activity had been conducted for 6 (six) years during 2010-2016. The activities of interpretation have produced 3774 sheets of Geological Maps of Remote Sensing Interpretation scale 1:50,000. Since 2017, maps continue updated base on field data.

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ENVIRONMENTAL GEOLOGY PROGRAMME

1.1. Summary
During the period of July 2017 to June 2018, the Center for Groundwater Resources and Environmental Geology (CGREG), Geological Agency (GA) conducted several activities related to environmental geology, including environmental geology mapping for land use planning and regional development, groundwater infiltration survey, geo-heritage inventory, karst inventory, CCS (Carbon Capture Storage) research in Karst, and mud flow disaster monitoring. In addition, the Geological Agency (GA) also has set up regulations related to Karst Conservation and Geology Conservation Area.

1.2. Annual Review of Individual Technical Activities
• The environmental geological mapping for land use planning and regional development activities were done in the urban areas and autonomy regions that have high priority in their development for geo-tourism. They include the national priority area that apply land use development and spatial planning with consideration of their geological phenomena. This activity has been carried out in regency/city of East Labuhan Bajo (East Nusatenggara), Toba Lake (North Sumatera), Mandalika (North Nusatenggara), Walini (North Java),
• Environmental geology survey in water infiltration was done in Depok (West Java). This activity aims to define the recharge zone due to land use change,
• Geo-heritage inventory was carried out in the Regency of Yogyakarta (Yogyakarta Special Province). This activity resulted an identification of specific geo-diversity that has a high value for scientific and tourism purposes,
• Karst inventory was done in the Regency of Sukabumi (West Java), Buru (Maluku), Sorong (North Papua), Pangandaran (West Java),
• CCS (Carbon Capture Storage) research in Karst, a new subject of research that was done in Karst Gunung Sewu. This activity is research-based monitoring of carbon uptake, water discharge and infiltration in karst caves,
• Mud flow disaster monitoring was done in Sidoarjo (East Java). This activity aims to see the changes of mudflow disaster after year 2006 in series, including debit, crack, subsidence, and blow-out,
• According Government Regulation No. 26/2008 on National Spatial Planning, mentioned that Geological Heritage Area should be protected. Based on Minister of Energy and Mineral Resources (MEMR) Regulation No. 17/2012 in Karst Conservation Area, Geological Agency (GA) and Minister of Energy and Mineral Resources (MEMR) Regulation No. 32/2016 in Geological Conservation Area evaluated some area that are important to be declare.

1.3. Proposed Future Activities

Similar environmental geology programme will be carried out in other part of the country. Preliminary study on CCS research in Gunung Sewu, Central Java will be a guidance for similar study in some areas of Indonesia. Geological Agency has been conducting evaluation of Karst in Kerawang Jambi, as well as Geological Conservation in Yogyakarta and Bojonegoro (East Java) that will be declared by the end of year 2018.

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GEOHAZARD PROGRAMME

1.1. Summary

Geohazards (volcanic eruption, earthquake, tsunami, and landslide) mitigation program in Indonesia is mostly implemented by the Centre for Volcanology and Geological Hazard Mitigation (CVGHM), Geological Agency. Main task of CVGHM is to conduct research, investigation and services of volcanology and geological hazard mitigation. Based on Presidential Regulation of Republic of Indonesia No. 9/2016 on one-map policy, preparation of geological hazard maps becomes the authority and responsibility of the Ministry of Energy
and Mineral Resources (MEMR), which is implemented by the Geological Agency (CVGHM). Therefore, in the period 2016 – 2019, geohazard program are prioritized to support the one-map policy.

One of the efforts in geohazards mitigation is to disseminate information and recommendations on geohazards to the community. Since 2015, CVGHM has created and developed MAGMA Indonesia (Multiplatform Application for Geohazard Mitigation and Assessment in Indonesia). This application contains integrated geological hazard information and recommendation presented to the community in a quasi-realtime and interactive manner. MAGMA Indonesia can be accessed at https://magma.vsi.esdm.go.id/.

1.2. Annual Review of Individual Technical Activities
1.2.1. Volcano

Indonesia hosts 127 active volcanoes and 69 of them are categorized as persistently active and high risk volcanoes, which are monitored continuously by CVGHM. During the period of July 2016 until June 2017, there were 11 volcanoes that erupted (Table 1) and six of them (Semeru, Sinabung, Bromo, Dukono, Ibu and Kerinci) have been erupting intermittently or continuously. Fortunately, there were no casualties caused by those eruptions. Currently there are 21 volcanoes whose activities are in a state above normal (Figure 3), consisting of one volcano at alert level IV (Sinabung), one volcano at alert level III (Agung) and 19 volcanoes at alert level II (Marapi, Kerinci, Dempo, Anak Krakatau, Merapi, Semeru, Bromo, Rinjani, Sangeangapi, Rokatenda, Ili Lewotook, Banda Api, Soputan, Karangetang, Lokon, Dukono, Ibu, Gamkonora and Gamalama).

Table 1. Volcanic eruption in Indonesia during the period of July 2017 – June 2018

<table>
<thead>
<tr>
<th>Volcano</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semeru</td>
<td>Intermittent explosion continuously since 2009 up to now</td>
</tr>
<tr>
<td>Sinabung</td>
<td>Explosions and phyroclastic flows continuously since 15 September 2013 up to now. The largest eruption occurred on February 19th 2018.</td>
</tr>
<tr>
<td>Marapi</td>
<td>Eruption on May 2nd 2018 at main crater with column eruption height of 4000 meters from the summit and April 27th 2018 with small eruption.</td>
</tr>
<tr>
<td>Dieng</td>
<td>Phreatic eruption at Sileri crater on July 1st 2017.</td>
</tr>
<tr>
<td>Dukono</td>
<td>Eruption and ash emission is continuing with maximum height 1300 m of volcanic ash column.</td>
</tr>
<tr>
<td>Ibu</td>
<td>Eruption is continuing with maximum height 600 m of volcanic ash column along with lava dome formation.</td>
</tr>
<tr>
<td>Anak Krakatau</td>
<td>Strombolian eruption start from July 14th 2018 and the largest strombolian eruption on August 3rd 2018 up to now.</td>
</tr>
<tr>
<td>Merapi</td>
<td>Explosive eruption on May 11th 2018 with column eruption height of 6000 meters from the summit.</td>
</tr>
<tr>
<td>Agung</td>
<td>Ash Eruption start from November 12th 2017 following by lava dome growth at the main crater up to now.</td>
</tr>
<tr>
<td>Batutara</td>
<td>Continuous strombolian eruption from 2007 up to now.</td>
</tr>
</tbody>
</table>
1.2.2. Earthquake

During period of July 2017 to June 2018 there are thirteen destructive earthquakes occurred in Indonesia, as summarized in Table 2 and Figure 4. The earthquake events caused 10 casualties, 186 people are injured and thousands of damaged building. Most of destructive earthquakes related to shallow depth events, which are caused by the movement of active faults and several of them have not been previously defined. In Indonesia, there are plenty of active fault that have not been defined due to lack of detailed research on active fault as well as lack of information on historical earthquake.

Table 2.
Destructive earthquake period July 2017 – June 2018 in Indonesia

<table>
<thead>
<tr>
<th>No.</th>
<th>Earthquake Location</th>
<th>Date of Event</th>
<th>Lon</th>
<th>Lat</th>
<th>Depth</th>
<th>Mag</th>
<th>Max Intensity</th>
<th>Fatalities</th>
<th>Injured</th>
<th>Moderate to Severely Damaged Building</th>
<th>Slightly Damaged Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Padangsidempuan, North Sumatra</td>
<td>14-Jul-17</td>
<td>99.15</td>
<td>1.42</td>
<td>10</td>
<td>5</td>
<td>V</td>
<td>0</td>
<td>1</td>
<td>26</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>Jolo, North Maluku</td>
<td>29-Sep-17</td>
<td>127.54</td>
<td>0.99</td>
<td>10</td>
<td>5</td>
<td>IV</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Lembeh, East Nusa Tenggara</td>
<td>10-Oct-17</td>
<td>123.37</td>
<td>-8.23</td>
<td>10</td>
<td>4.9</td>
<td>V</td>
<td>0</td>
<td>2</td>
<td>59</td>
<td>154</td>
</tr>
<tr>
<td>4</td>
<td>Amboe, Maluku</td>
<td>31-Oct-17</td>
<td>127.85</td>
<td>-3.69</td>
<td>10</td>
<td>6.2</td>
<td>V</td>
<td>0</td>
<td>0</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>Morotai, North Maluku</td>
<td>18-Nov-17</td>
<td>128.17</td>
<td>2.61</td>
<td>10</td>
<td>5.8</td>
<td>V</td>
<td>1</td>
<td>63</td>
<td>253</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Lebong, Bengkulu</td>
<td>6-Dec-17</td>
<td>102.15</td>
<td>-3.16</td>
<td>10</td>
<td>5.1</td>
<td>V</td>
<td>0</td>
<td>1</td>
<td>114</td>
<td>119</td>
</tr>
<tr>
<td>7</td>
<td>Tasikmalaya, West Java</td>
<td>15-Dec-17</td>
<td>108.11</td>
<td>-7.75</td>
<td>107</td>
<td>6.9</td>
<td>VI</td>
<td>4</td>
<td>5</td>
<td>2641</td>
<td>3918</td>
</tr>
<tr>
<td>8</td>
<td>Lebak, Banten</td>
<td>23-Jan-18</td>
<td>105.91</td>
<td>-7.21</td>
<td>53</td>
<td>6.1</td>
<td>V</td>
<td>3</td>
<td>65</td>
<td>3968</td>
<td>5061</td>
</tr>
<tr>
<td>9</td>
<td>Pidie, NAD</td>
<td>08-Feb-18</td>
<td>98.27</td>
<td>-4.66</td>
<td>10</td>
<td>5.8</td>
<td>V</td>
<td>0</td>
<td>0</td>
<td>47</td>
<td>31</td>
</tr>
<tr>
<td>10</td>
<td>Boven Digoel, Papua</td>
<td>26-Feb-18</td>
<td>147.72</td>
<td>-6.09</td>
<td>96</td>
<td>7.6</td>
<td>VII</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>Banjarbaru, Central Java</td>
<td>30-Apr-18</td>
<td>109.65</td>
<td>-7.21</td>
<td>4</td>
<td>4.4</td>
<td>V</td>
<td>2</td>
<td>41</td>
<td>413</td>
<td>280</td>
</tr>
<tr>
<td>12</td>
<td>Sumenep, Madura</td>
<td>13-Jun-18</td>
<td>113.94</td>
<td>-6.88</td>
<td>12</td>
<td>4.8</td>
<td>VII</td>
<td>0</td>
<td>3</td>
<td>27</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>Sarmi, Papua</td>
<td>15-Jun-18</td>
<td>138.93</td>
<td>-1.97</td>
<td>10</td>
<td>5.7</td>
<td>IV</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>44</td>
</tr>
</tbody>
</table>
1.2.3. Tsunami

In the past year (July 2017 to June 2018), there was no tsunami event occurring in Indonesia. However, tsunami mitigation efforts such as tsunami hazard mapping and tsunami deposit investigation are still carried out by CVGHM (Figure 5). Tsunami hazard mapping was conducted along the coastal area of north Bali and Gunung Kidul (Yogyakarta), whereas investigation of tsunami deposit was conducted at coastal area of Gunung Kidul (Yogyakarta). Tsunami hazard maps are generated based on tsunami hazard modeling with data input from various literature and supported by field data. The results of the study and tsunami hazard maps were finally reported to the local government.

1.2.4. Landslides

Landslides disasters in Indonesia mostly occur during the rainy season or between Octobers to June for every year. During the period of July 2017 - June 2018, in total there were 1473 landslide events in Indonesia caused 185 casualties, 153 people injured and thousands of damaged houses and building. Java is the most vulnerable island to landslide disaster in
Indonesia, where 64% of landslide event and 72% of casualties occurred in Java Island (Figure 6 and 7). This is due to geological condition of Java Island coupled with high population density, and also because of Tropical Cyclone Cempaka hit Southern Part Java Island causing floods and landslide at 28 November 2017. During this period, the most destructive landslide event occurred in Ponorogo, Pacitan Regency, East Java, Yogyakarta and Central Java. Cyclone Cempaka at Pacitan at least 19 dead because of landslide, 22 missing because of flood. The cyclone, which formed in late November off the southern coast of Java, also damaged nearly 5,000 houses, 36 bridges and 21 schools. Technical recommendations were finally reported to the local government to minimize the landslide risk during rainy season.

Figure 6. Landslide disaster event in Indonesia during the period July 2017 – June 2018
Figure 7. Casualties caused by landslide in Indonesia, July 2017 – June 2018

Figure 8. Houses buried by landslide induced by Tropical Cyclone Cempaka at Ciwalan Sub Village, Ponggok Village, Pacitan District, Pacitan Regency, East Java
1.2.5. Training activities

During period of July 2017 to June 2018, there were two geological agency staff who participated in geohazard-related CCOP technical activities, namely:

(1) Merry Christina Natalia who has participated in the 2nd BGR-CCOP International Training Course on ‘Risk-Sensitive Spatial Planning in CCOP Member Countries’ in Quezon City, Philippines, on 18-28 September 2017;

(2) Imun Maemunah participated in Regular Training Course on “Coastal geology, Geohazards and Management (GeoCoast) on 27 November to 1 December 2017, at IS-Geo KIGAM, Daejeon, Korea.

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GROUNDWATER PROGRAMME

1.1. Summary
Following the main tasks of the Center for Groundwater and Environmental Geology (CGEG), Geological Agency (GA), during the period of year 2017 and 2018 (July 1, 2017 – June 30, 2018), the office conducted four main activities, i.e.:

1. Finishing the systematic hydrogeological mapping program in a scale of 1:100,000,
2. Groundwater survey based on groundwater basin (GB),
3. Groundwater exploration and deep wells development in water shortage areas across Indonesia,
4. Preparing ministerial regulation (regulation of the ministry of Energy and Mineral resources) on groundwater as an instrument to manage groundwater in Indonesia.

The results of the above activities were disseminated to the groundwater stakeholders by conducting workshop, seminar, and socialization.

1.2. Annual Review of Technical Programme/Activities
Detailed activities related to groundwater which were conducted by CGEG-GA during the period of July 1, 2017 to June 30, 2018 can be described as follows (see Table 1 and Table 2).

1.3. Hydrogeological/Groundwater Mapping
The main objective of the hydrogeological mapping scale of 1:100,000 is to provide more detailed and user-friendly maps based on the One Map Policy standard.

Hydrogeological mapping based on systematic sheet of Indonesia scale 1:100,000 conducted in this year consists of 612 quadrangles, distributed in 17 provinces, as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Num. of Location (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Systematic Hydrogeological Mapping Scale 1:100,000</td>
<td>612 sheets</td>
</tr>
<tr>
<td>1.1</td>
<td>6 provinces in Java island</td>
<td>93 sheets</td>
</tr>
<tr>
<td>1.2</td>
<td>East Nusa Tenggara</td>
<td>57 sheets</td>
</tr>
<tr>
<td>1.3</td>
<td>West Nusa Tenggara</td>
<td>27 sheets</td>
</tr>
<tr>
<td>1.4</td>
<td>Riau Archipelago</td>
<td>47 sheets</td>
</tr>
<tr>
<td>1.5</td>
<td>Bangka Belitung</td>
<td>24 sheets</td>
</tr>
<tr>
<td>1.6</td>
<td>North Maluku</td>
<td>58 sheets</td>
</tr>
<tr>
<td>1.7</td>
<td>5 Provinces in Kalimantan Island</td>
<td>300 sheets</td>
</tr>
<tr>
<td>1.8</td>
<td>Bali</td>
<td>6 sheets</td>
</tr>
<tr>
<td>2</td>
<td>Groundwater Survey</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Survey on Groundwater Potency of the Groundwater Basin (GB)</td>
<td></td>
</tr>
<tr>
<td>2.1.1</td>
<td>Muara Lahai GB, Kalimantan</td>
<td>3 GB</td>
</tr>
<tr>
<td>2.1.2</td>
<td>Watuputih GB, Rembang Regency, Central Java</td>
<td>(2017)</td>
</tr>
<tr>
<td>2.1.3</td>
<td>Industrial Areas in Serang Tangerang GB, Banten</td>
<td>(2017)</td>
</tr>
<tr>
<td>2.2</td>
<td>Survey on Groundwater Conservation of the GB</td>
<td></td>
</tr>
<tr>
<td>2.2.1</td>
<td>Serang Tangerang GB</td>
<td>2 GB</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Muara Lahai GB</td>
<td>(2017)</td>
</tr>
<tr>
<td>3</td>
<td>Groundwater Exploration and Development in Area of Water Shortage in 26 provinces</td>
<td></td>
</tr>
</tbody>
</table>
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N
o
o
Description
Num. of Location
(Year)
4 Preparing Ministerial Regulation on Groundwater Management in Indonesia
1.1 Regulation on The Guidance of Value of Groundwater Price for Groundwater Tax Calculation
1.2 Regulation on The Guidance of Groundwater Conservation Zonation
(2017)
(2018)

- **Groundwater Survey Based on Groundwater Basin**

In this period, this survey was focused on investigation of the groundwater resource and groundwater conservation mapping. The survey were conducted in three groundwater basins, i.e.:

1. Muara Lahai Groundwater Basin, an inter-provincial groundwater basin in Kalimantan Island,
2. Watuputih Groundwater Basin an intra-provincial groundwater basin in Central Java Province,

- **Groundwater Exploration and Development in Area of Water Shortage**

Groundwater exploration and development in area of water shortage were carried out in 26 provinces. Total number of exploration wells which were then developed for groundwater production are 250 wells.


<table>
<thead>
<tr>
<th>No</th>
<th>Location (Province)</th>
<th>Number of Well</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>West Java</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Central Java</td>
<td>27</td>
</tr>
<tr>
<td>3</td>
<td>Yogyakarta</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>East Java</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>West Nusa Tenggara</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>East Nusa Tenggara</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Nanggroe Aceh Darussalam</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>North Sumatera</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>West Sumatera</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>South Sumatera</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>Riau</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>Jambi</td>
<td>7</td>
</tr>
<tr>
<td>13</td>
<td>Lampung</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>Bengkulu</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>West Kalimantan</td>
<td>6</td>
</tr>
<tr>
<td>16</td>
<td>South Kalimantan</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>North Kalimantan</td>
<td>5</td>
</tr>
<tr>
<td>18</td>
<td>East Kalimantan</td>
<td>8</td>
</tr>
<tr>
<td>19</td>
<td>South East Sulawesi</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>South Sulawesi</td>
<td>15</td>
</tr>
<tr>
<td>No</td>
<td>Location (Province)</td>
<td>Number of Well</td>
</tr>
<tr>
<td>----</td>
<td>---------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>21</td>
<td>West Sulawesi</td>
<td>4</td>
</tr>
<tr>
<td>22</td>
<td>Central Sulawesi</td>
<td>4</td>
</tr>
<tr>
<td>23</td>
<td>Gorontalo</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td>North Sulawesi</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>Maluku</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td>Papua</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>250</td>
</tr>
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</table>

**Preparing Ministerial Regulation on Groundwater Management in Indonesia**

Regarding to the Presidential Decree No. 43/2008 on Groundwater, 23 technical regulations should be prepared by The Ministry of Energy and Mineral Resources as the administrator of groundwater management in Indonesia.

In the period of of 2017 to 2018, 2 regulations were prepared by The Ministry of Energy and Mineral Resources, i.e.:

1. Regulation on The Guidance of Value of Groundwater Price for Groundwater Tax Calculation,

**1.4. Proposed Future Activities**

After 30 June 2018, the CGEG-GA conducting several activities as follows:

1. Preparing Ministerial Regulation on Groundwater Management in Indonesia,
2. Groundwater Exploration and Development in Area of Water Shortage,
3. Dissemination of the result of groundwater activities conducted by the CGER-GA.

**1.5. Assistance Required from CCOP/Other Member Countries in Support of Future Activities**

Technical assistance from CCOP members required are lesson learns and training for:

1. Groundwater quantity and quality monitoring in urban groundwater basins (network design of groundwater monitoring wells, installation, expertise and budget),
2. Groundwater quantification and modeling in urban development groundwater basins (expertise, training, budget).

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ENERGY PROGRAMME

1.1. Summary
A brief list of activities related to energy development, in particular oil and gas, during the period of June 2017 to June 2018 are exploration for new oil and gas working area (block) in frontier areas; re-assessment and adding more valuable data for the unsold block; exploration for biogenic gas; exploration of unconventional gas such as coalbed methane (CBM) and shale gas reservoir; and enhanced oil recovery (EOR).

In order to be more efficient and attracting more investment, the Indonesian government also has simplified regulation in oil and gas industry, as well as implementing gross-split scheme for new oil and gas blocks since 2017.

Exploration and Development of CBM is still continuing, some CBM Fields in Eastern Kalimantan (Kutei Basin) already in production, while some of them waiting for POD (Plan of Development) approval. Shale gas reservoir pilot project in the North Sumatera Basin was drilled in 2017 (Meulucut-1 Well) and the advanced study to evaluate the shale potential still in progress. In addition, shale gas mapping in Jambi Sub-Basin also still continue to estimate the resources.

1.2. Annual Review of Technical Programs/ Activities

- Oil and gas exploration activities in frontier areas of Eastern Indonesian Region have been conducted by Geological Agency including Seismic acquisition in Aru Sea and Arafura sea. Exploration for shallow gas biogenic had been conducted by “LEMIGAS” together with Research and Development Center for Marine Geology in Sibolga Basin and Kangean Area. Most of the target areas are located in offshore, and some of them lay in the deep sea. Some of potential area also located in the cross border area such as in Aceh and North Sumatra offshore, West Timor, and Central Papua, therefore it need more cooperation with neighbour country to explore the resources.

- Re-assessment the unsold blocks conducted by the Research and Development Centre for Oil and Gas Technology “LEMIGAS” to add valuable data quality and improve exploration concept within the blocks. The main goal of this activity is to make the unsold Blocks to be more attractive for investors. In 2017, 10 blocks of oil and gas need for evaluation. The basins located in Eastern Indonesian Region (Figure 11).

- Exploration of un-conventional gas such as Coal Bed Methane (CBM) and shale gas is another main target in oil and gas sector to increase gas production. Today Indonesia has 43 CBM Blocks that located in Sumatra and Kalimantan Islands. Geological Agency and Research and Development Agency are also performing shale gas mapping in South Sumatera Basin to access the potential of gas resource.
Figure 10. Oil and Gas Working Areas of Indonesia as of 1 February 2017

Figure 11. Location Map of unsold blocks to be re-assessed in 2017
Figure 12. Indonesian oil reserve as of 1 January 2017

Figure 13. Indonesian gas reserve as of 1 January 2017
For several years, the Research and Development Centre for Oil and Gas Technology “LEMIGAS” has carried out collaboration with worldwide organizations such as JAPEX, KIGAM, ADB and World Bank to investigate the potential for deployment and development of Carbon Capture Storage (CCS) in Indonesia. In order to anticipate the implementation of CCS technology in Indonesia, LEMIGAS has been successfully mapping potential geological formations for CO2 storage across the country along with their storage capacity.

The first shale hydrocarbon well in Indonesia was drilled by PERTAMINA in late 2016, located in Tamiang Deep, North Sumatra Basin. The well reaches 3,800 m TD, penetrated Lower Baong Shale with 1,900 m thickness. Laboratory analysis, such as RCAL-SCAL-XRD-SEM and G&G evaluation were undertaken by LEMIGAS to obtain comprehensive results including regional geology, geochemistry, petrophysics, basin modeling, and static modeling. In North Sumatra, the most important source rock is from Bampo Fm, the syn-rift sediment in this basin. Unlike many Paleogene syn-rift in Indonesia, this Bampo Fm is deposited in a marine setting. However, the available data and study related to this Bampo Fm is quite scarce. LEMIGAS has conducted several shale gas studies to assess Bampo source rock in North Sumatra Basin in 2013 and 2017.

1.3. Proposed Future Activities

- Exploration in the frontier areas that lack of data and infrastructure, especially in the off-shore and deep sea area need for knowledge sharing and technical assistance from the CCOP Networking,
- Sharing best practices and lessons learn from CCS projects in conjunction with EOR or enhanced gas recovery (EGR),
- Sharing best practices and lessons learn in developing unconventional hydrocarbon resources, such as coalbed methane and shale gas reservoir,
- Sharing best practice and lessons learn from hydrocarbon exploration in cross border area,
• Sharing and discussion for unconventional operation since it needs a massive equipment for drilling and development operation.
• Sharing and discussion for unconventional exploration regulation adopted from cross border country, since it needs a more simple and better regulation from government,
• Sharing and discussion for unconventional exploration study and play concept, especially in microscopic to nanoscopic scale.

Figure 15. Indonesia Unconventional Basin Potential

Figure 16. Speculative resource of CBM and shale gas in Indonesia Basin (Directorate General of Oil and Gas)
Table 5.
Unconventional resource calculation in PERTamina working area

<table>
<thead>
<tr>
<th>Formation</th>
<th>Shale Reservoir</th>
<th>Tight Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OOIP (MMBO)</td>
<td>OGIP (TCF)</td>
</tr>
<tr>
<td>Lower Baong</td>
<td>306.76</td>
<td>1.99</td>
</tr>
<tr>
<td>Belumai</td>
<td>90.39</td>
<td>9.64</td>
</tr>
<tr>
<td>Bampo</td>
<td>163.21</td>
<td>12.05</td>
</tr>
<tr>
<td>Total</td>
<td>560.36</td>
<td>23.68</td>
</tr>
</tbody>
</table>

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MINERALS PROGRAMME

1.1. Summary
Prohibition of raw materials export and bidding policy of metal mineral mining permit which is the implementation of Law No.4/2009 on Mineral and Coal Mining is one of the weak factors of mineral mining activities in Indonesia. On the other hand, this is an opportunity to control permit business in several regions and increase the added value of minerals through processing and refining Several types of commodities show a trend to decrease total resources, as well as production of some minerals that tend to decline since the introduction of a ban on export of raw materials in 2014.

1.2. Annual Review of Individual Technical Activities
During July 2017 – June 2018 period, Geological Agency conducted mineral exploration at several areas.
In the second semester of 2017, mineral exploration conducted at Malaka, East Nusa Tenggara, Mandailing Natal, North Sumatera, Sanggau and Bengkayang, West Kalimantan.
In the first semester of 2018, mineral exploration has been done at Kapuas Hulu and Sambas, West Kalimantan, Central Halmahera, North Maluku, and Pati, Central Jawa.

![Bar charts of some mineral commodities resources and reserves of Indonesia 2014 – 2017](image)

*Figure 18. Bar charts of some mineral commodities resources and reserves of Indonesia 2014 – 2017*
Figure 19. Location Map of Mineral Survey in 2nd Semester 2017 – 1st Semester 2018
On the basis of MoU 2010 signed by Head of Geological Agency of Indonesia and Head of China Geological Survey, Center for Mineral, Coal and Geothermal and Wuhan Center followed up with Technical Agreement of *Cooperative Project on Geochemical Mapping and Mineral Resources Assessment* 2011-2014 and the result is a geochemical map and new mineral prospect area of 16 locations within an area of 18,000 km². As a continuation, the Technical Agreement was signed for 2016-2019 on September 8, 2016 in Nanning with semi geochemical geochemical mapping work of Sumatra 1: 1,000,000.

This geochemical mapping is the mission of the UNESCO International Center on Global-Scale Geochemistry (ICGG) in preparing Global-Scale Geochemical Mapping. ICGG stands in Paris France in 2013 operating under the support of the Chinese Government. CGS Wuhan Center is appointed to carry out activities. The mapping area will cover 16 countries: Brunei, Cambodia, China, Indonesia, Japan, South Korea, Laos, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Singapore, Thailand, Timor Leste, Vietnam.

*Figure 20. Location Map of Joint Study Geochemical Survey CGS- CMCGR*
1.3. Assistance Required from CCOP/Other Member Countries in Support of Future Activities

- Capacity building program in exploration methodology aspects and also training program for integrated geophysical and geochemical data interpretation purposes especially for REE are needed in order to achieve expected exploration targets and to get more new prospect discoveries.
- The exchange of various exploration experiences through establishment of special forum dealing with relevant and actual issues between CCOP member countries would be helpful to cope with exploration problems encountered in any exploration project plan.

1.4. Others Comments

Direct responses on reviews mentioned above for improvement of project outcomes and for perfecting any exploration plans would be kindly required from technical director of CCOP.

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1.1 Summary
During the period of July 2017 to June 2018, the Marine Geology Institute of Indonesia (MGI) or Research and Development Centre of Marine Geology (part of Agency of Research and Development for Energy and Mineral Resources) conducted several activities related to coastal geology, including: coastal characteristic mapping, inventory of energy and mineral placer deposit, coastal dynamics and coastal geological hazard.

Coastal geology mapping to understand geological aspects as a component that influences the type and distribution of mineral placer and coastal dynamics, as a basis for the utilization of the ESM sector and others also has set up regulations related to energy and mineral policy and regional development planning.

1.2. Annual Review of Individual Technical Activities
Marine Geological Institute (MGI) of Indonesia has conducted coastal (and offshore) mineral investigation at several areas. In the second semester of 2017, mineral exploration conducted at Western Bangka Coast and its surrounding area, Bangka Belitung Province and Enggano Island, Bengkulu Province and South Halmahera, North Maluku Province. In the first semester of 2018, mineral exploration has been done on Southern Lampung Waters. Meanwhile, Marine geological mapping will conduct on September and October 2018 on Waipoga Waters, Papua Province and Kai Waters to obtain marine geological and geophysical data for hydrocarbon exploration (Figure 22).

On Bangka Coast, the investigation was aimed to know the type and content of heavy minerals as well as the variations and concentration of REE and to obtain the preliminary data on the pattern and distribution of ancient valleys as associated with geological aspects as well as coastal dynamic condition, while on South Lampung waters to get information of marine aggregate distribution and its textural relation to Krakatoa eruption.
On Enggano Island and its Waters, Bengkulu Province and South Halmahera Waters to get of ocean renewable energy data, such as: wave, tide and current;

Marine Geological Institute (MGI) of Indonesia as data provider, since 2017 has been developing the Marine and Coastal Geological Database of Indonesia. Considering to support of Maps Mineral Indonesia (MoMi) which the large number of data and rapid increase the demands of the geological data, the database system is continuously developed and updated.

Since 2017, MGI has changed its form to a Public Service Agency with this status, MGI can make direct employment contracts with 3rd parties.

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2. COOPERATION AND PARTNERSHIP

2.1. Summary

A number of cooperation among institutions have been carried out for Energy Program, so that the studies can be performed well. Research and Development Center for Oil and Gas Technology “LEMIGAS” carried out cooperation and partnership with international organizations such as JAPEX, SOJITZ, JICA, ADB, BAATTELLE in regard with CCS, CCUS, CCUS-EOR programs. During April 2018, Battelle’s project team, consisting of representatives from Battelle, Trimeric Corp., Serenity West Pacific Corp., Elnusa, and Core Energy visited Indonesia, as part of the ADB Mission to review the readiness of two locations for CCS pilot projects, Gundih and Merbau-Beringin sites.

April 17-26 2018 a field trip was undertaken by a team of experts, from Battelle and its team members, from varying backgrounds to review two potential pilot CO2 storage pilot projects in Indonesia. The first was a Carbon Capture and Storage (CCS) project in the Gundih block of central Java. The second was a Carbon Capture Utilization and Storage (CCUS) project in Merbau-Beringin South Sumatra. The five (5) spot wells were selected in regard with Beringin CCUS Pilot. The team consisted of experts in CCS field projects, surface facilities, EOR and oilfield operations. The team is currently analyzing the information presented during the visit and information that has been requested to aid in giving an unbiased review and recommendation of both projects. EOR is not practiced in Indonesia at present, but it is expected that EOR technology will start to be exploited in South Sumatra from about 2020.

Cooperation between LEMIGAS and KOGAS (Korea Gas Corporation) has also been conducted for the study about CBM Potential in Indonesian Basins, with focus on Kutei Basin. This work on the study of coal bed methane (CBM) potential in Indonesia was initiated through the 8th Indonesia-Korea Energy Forum, held on October 2015, that resulted an MOU between the Agency for Research and Development of Energy and Mineral Resources (ARDEMR) & KOGAS (CBM) on May 2016. A month after the 9th Indonesia-Korea Energy Forum, on October 2016, meeting between LEMIGAS and KOGAS was held to discuss the scope of CBM study contract. This study reassesses the speculative CBM resource in
Indonesia, reaches 150 Tcf. It is lower than the first published CBM resources estimation from Steven and Hadiyanto (2004) which was 453 Tcf. However, this is still economically supported as well by the gas business, facility and infrastructure opportunity in Indonesia especially in Kutei Basin as the selected basin study. To sum up, Indonesia has CBM potential which may be taken into account for both additional national source of energy consumption and international gas business market.

Cooperation with National institutions includes PT. PERTAMINA and Pertamina University has also been performed on the Shale Characteristic Study for Unconventional Hydrocarbon. This collaboration has revealed a new potential and calculation for shale gas, shale oil, tight sand gas, tight sand oil respectively. This resource has been updated from a new seismic, lab, and well data, tied to petrophysic, geochemistry, basin modeling, and static modeling analysis to enhance the knowledge of unconventional hydrocarbon resource and habitat in the North Sumatra Basin.

2.2. Annual Review of Individual Technical Activities

The Merbau-Beringin project offers an opportunity to test the CO2 storage associated with the CO2-EOR processes. There are significant number of oil/gas fields in Indonesia with high CO2. The existing oil fields are also reaching the end of primary production but there is significant remaining oil in place, which could be recovered with CO2-EOR. The Beringin field pilot will help develop domestic capabilities for low-carbon oil production. However, a number of issues need to be resolved for the project to move forward. At the reservoir side, the could be greater optimization and assessment of the wells used for the pilot flood and an improved assessment of the role of faulting on EOR performance. Transportation of CO2 from Merbau to Beringin is a major concern due to the lack of paved road over 22 km and the poor condition of the remaining paved road. A number of alternatives were discussed to enable the pilot project, while reducing the risk posed by extended truck transport.

2.3. Proposed Future Activities

Sharing best practices potential detectability of CO2 using seismic. Start with oil, gas, and CO2 saturations map prior to CO2 injection. Carry out forward modeling of seismic response using saturation field and appropriate velocity model integrated with rock physics analysis. Examine potential for seismic method to detect change in seismic attribute induced by these saturation changes.

2.4. Assistance Required from CCOP in Support of Future Activities

Sharing best practices CO2 plume monitoring by using geophysical passive method (microgravity or passive seismic)

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