A SCIENTIFIC CONCEPT APPLIED TO THE POSSIBILITY OF FINDING GEOTHERMAL PROSPECTS IN KALIMANTAN/BORNEO MAINLAND

Vincent T. RADJA

Indonesia State Electricity (PT. PLN PERSERO)

ABSTRACT

Based on existing information Indonesia archipelago is fortunate to be potentially rich in geotehrmal resources except Kalimantan Mainland does not seem be promising of geothermal area but surprises are not possible.

Under the ASEAN Utility/Authority Cooperation on Geothermal Energy Development since 1982, studies been made on the possibility to developed geothermal as an alternative energy resources in the member countries including Sabah in Malaysia and Kalimantan Indonesia. Analysis been made based on the existence of structure, lithology, volcanology, mineral association etc.

Correlation ben made with the others developed geothermal countries such as Philippines, PNG, USA, Iceland, Japan, Italy and CHINA.

The paper try to pinpoint the possibility to find same geothermal spot either in Kalimantan or Borneo (Sabah) and recommend that follow up action survey, exploration to be made on finding geothermal potential area in Kalimantan/Borneo mainland.

The scientific concept applied here be directed to the indication of pretertiary deep granles (neogranite?) Found in Kalimantan and young volcanic manifestation in Borneo (Sabah).

The paper open for discussion both International as well as National geothermal forums such as IGA, GRC, CEPSI, NEDO, ASEAN, as wells as INAGA.

INTRODUCTION

Kalimantan/Borneo **attachment I** mainland underlain mainly by the Cretaceus - Lower Tertiary rocks composed of granite and andesite. Dacitic lava and pyroclatics are exposed mainly in several areas besides sediments of shale, mudstone tuff and conglomerate.

Generally there are 2 group geothermal prospects :

1. Young volcanic activities as in Borneo (Sabah)
2. Geothermal related to Pre Tertiary (NeoGranite) in Kalimantan and extended to Southern part of Sumatera.

The volcanic lavas, where exposed are well jointed and commanly hydrothermally altered. Hydrothermal alteration is well exposed in the summit area of severals younger mountain in Sabah and Kalimantan. Hot Spring are the only surface manifestation of remnart thermal activity.

There is sufficient existence of a geothermal resources in Sabah and Kalimantan However more detailed investigations have to be carried out. In order to have a clear pictures of the geothermal prospects. Correlation studies been made between Kalimantan/Borneo with the existing geothermal prospects in PNG, USA, JAPAN, CHINA and ITALY.

Some structural evidences shows that geothermal potential in Kalimantan-Borneo is the extension of Philippines geothermal mountain range.

Geothermal evidences in Kalimantan related to intrusion of plutonic granite mass and possible association in with epithermal gold, cooper and mercury known since 1850 by Ducth Chinese and Italiyan. To meet the rapidly in creasing demand for electricity in these areas facing the year 2020 (globalization), APEC, or AFTA exploration for geothermal prospects should be extended in Kalimantan/Borneo mainland.

THE GEOLOGICAL OUTLINE OF KALIMANTAN/BORNEO

With relation to geothermal prospects, the geology of Kalimantan/Borneo be Divided into 3 areas :

1. West and Central Kalimantan
2. North East Kalimantan
3. North Borneo (Sabah)

Volcanic activities in these region started from End of Palawan to End of Neograne

1. West and Central Kalimantan

The youngest formation of these areas is acapping of volcanic rocks in the apoliagan and Nilean hais mountain within 30 km wide and 125 km long the volcanic complexs lies unconformably on the basement of Tertiary sediment.

The age of the volcanic complex is Plio Pliocese with the composition of basic intermediary the calc alcaline (besalt and andesite) more geothermal prospects be found in these areas.

2. North East Kalimantan

The aced volcanism is much younger (Pliocese) about the some age of the volcanic activity of the Sempurna Peninsula in Sabah (Borneo) and the Southern Part of Dent Peninsula of Sabah beloging to a belt of young Tertiary to quarternary volcanism these area covared young volcanic of Sulu as in Tanjung Seloma of Tarakan.

3. North Borneo (Sabah)

Belongs to the sphere of on fluence of the Philippines the Kinabalu Range night be as the Southern end of the Palawan Ridge (West Condileras of the luzon are) and Dent Peninsula links up with the Pangutarang Islands and Zamboangan Peninsula (East Condilleras of the Luzon the Meanwhile the Sulu Basin, along the Northern of the Dent Peninsula, WNW-ESE trending major faults are found on which mud volcanoes are situated.

These is the most prospects geothermal are recorded in Borneo. Generally the geology of the areas included in the : Pre Quaternary history of the Sunda Shelf Area. The pregranitc formation of the areas are Crystalline schets, Fuasic igneores Rocks of granites and diorites. Laritic antusion in West Kalimantan (Chinese Districst) have contact metamorphisically altered limestimes of jurassie age.

The zone extered to Tim granit belt Porphiric Biolite Granite of Bangka Belitung, Singkep and Sourthern most zone of Karimunjawa and Lampung Destrict in South Sumatera where we found geotehrmal manifestation as in Rajabasa Suoh Sekincau and Ratai. The Mountain system composed of Natuna zone, Inambas Zone, Karimata Zone, Jin Belt and Karimunjawa Zone.

BASIC CONCEPT RELATION BETWEEN GEOTHERMAL AND ORE DEPOSITS

1. Most of the metallic minerals mined in the world such as copper, gold, silver, lead, zinc, mercury associated with magmas found deep within the roots of extent volcanoes.

2. Rising magma does not always reach the surface to erupt, slowly cool and harden beneath the volcano to form variety of crystalline rocks called : PLUNTONIC OR GRANITIC ROCKS.

3. Ore deposits commonly form around the magma bodies that feed volcanoes because there are a ready supply of heat, which consecutively moves and circulation ore bearing fluids.

4. The metals, originally scattered in trace amounts in magma or surrounding solid rocks, become concentrated by circulating hot fluids and can be redeposited under favourable temperature and pressure conditions to form rich minerals veins.

5. The active volcanic vents along the spreading ocean ridges creates ideal environments for the circulation of fluid riches in minerals and for ore bearing deposit. Water as hot as 380°C gushes out of geothermal springs along the spreading zone heated during circulation by contact with the hot volcanic rocks. Deep heated sea hot spring contain abundance of dark colosed mineral ecaled, BLACK SMOKERS: Iron, copper, nickel of the dark coloured.

GEOTHERMAL INDICATIONS

Kalimantan means River of Diamond : Rich in Precious metals such as : gold, diamond, silver, and abundant of natural resources.

Geothermal resources in Kalimantan/Borneo mainland shows by [1] the existence of young Volcanoes. Elongation of high peak volcanoes with NE - SW direction from Sabah, Sarawak until west Kalimantan and East Kalimantan. Such as : Gn. Kinabalu (1995 m) and Trus Medi (2649 m) in Sabah and Gn. Mulu (2571 m) in Sarawak. West Kalimantan such as Gn. Kerihun, (1980 m), Gn. Mentuang Karimun (1767 m) and Gn. Raya (2278 m) and East Kalimantan with Gn. Murudi (1980 m) and Gn. Liong Pram (2240 m).Volcanic fire works happened about 4,5 million years ago and folding shifsed of Kalimantan and Borneo. Kinabalu in Sabah mean Api-api (fires) sho us : Volcanic activity. Geological expedition in these areas bescan : since 1851 by Chinese and Dutch. [2] Neo Granites in Kalimantan especially West and Central Kalimantan geothermal prospects related to Neogranites (Pre Tertiaary Granites) see Attachment II.

West Kalimantan near Mandor, Menpawah, Mantrado and Bengkayang geothermal prospect in association with epithermal gold, copper and mercury known since Hindu epochs (4 to 13 century) and followed by Chinese (1760) and Duth (1850) expeditions.

Central Kalimantan known as schwaner Belt, Near Kapuas & Barito and Kutai Berau shows by Intrussion of plutonic, rocks : of granite mass such as aplite granite Zone Volcanic rocks appears in the area known as Matau Complex. The finding of budge gold bearing mineral in Busang area possibly be related to neo volcanic activities.

STRUCTURAL EVIDENCES :

Structural geology related to the geothermal prospects be grouped in to : two groups

A. MEGA SCALES :

1. Extension of West and East Cordilleras mountain Range from Philippines as indicated by Palawan archipelago (west) and Mindanao (East). Tectonic structure control along with the volcanic activity.

2. Appearance of Mountain Range along Kalimantan and Borneo (Sabah) such as :

   - Kinabalu (Mount Api-api)
   - Schwaner
   - Muller
   - Raya

3. Volcanic rocks : Granit, Dacit
4. Mineral Association : Copper, (Poring), Mercury, (Lumor) Gold (Busang)
5. Methamorphic Rocks : as Chert, Splite.

B. MICRO SCALES

1. Appearance Hot Spring, Fumarola, Sinter Deposit (Andrasy, Balun, J. Jepun)
2. Young Volvcanic Cones : Magdalena, Maria, Lucia
3. VolcanicRocks : Granodiarite
4. Low Resistivity Anomsly 25 Ω m in Tawao
5. Mineralization : Calcitization, argilization, and chlorization

C. ZONE OF THE EASTERN CORDILLERAS (See Attachment III)

Extends from the Bondoc Peninsula of Luzon, Burias, Ticao, Eastern of Masbate, Northeast of Leyte then curves South/Soutward to Camotes Island, Bahol and Zamboanga. Then connected to Sulu archipelago with the Darval area of North Borneo, Tawao and Samporna.

The Sulu archipelago consists of two parallel ridges; one stretchning from Zamboanga to Peninsula North of Darval Bay carrying the coral reef island of the Panyutarang group; the other extending from the Sibugsy Peninsula via Basilan, Jolo, Tawitawi to the Peninsula South of Davel. Bay, these is a young volcanic belt extending to Tawao, Samporna Peninsula composed of granodiorit and geothermal manifestation.

D. ZONE OF THE WESTERN CORDILLERAS

Passes via Lubang Island and the Mindoro to the Calamian Islands, Cuy Islands, Palawan and Balabac. The trend of the Palawan block has a NNE-SSW direction. These trend consists of extinct volcanic of Plio-Pleistocene age, as the continuation of volcanic Miravales Chain. A younger submarine volcanoes is found between Cagayan Sulu and the Cagay areas Island and the Sulu trough until Kinabalu range consist of basalt and andesites and hot spring.

CORRELATION BASED ON GEOSCIENTIFIC EVIDENCES

Correlation based on scientific evidences such as geothermal system and neo-granite, be made between Indonesia, Malaysia, China, Italy, USA, JAPAN especially on : Manifestation, geological stages, petrology, geological structure and volcanic activity. Attachment IV

CONCLUSION

1. Neo-granite geothermal concept or Deep Seated Geothermal Concept reservoirs are closely related with intrusive bodies with shows the characteristics of both vapor dominated and liquid dominated geothermal systems. These prospects possibly be found in Kalimantan.

2. Neo-granite or Deep Seated Geothermal Concept can be applied to old volcanic areas such as : Lardarello, Italy, The Geyser USA, Kakkonda Japan, Tongonan Palimpinon Philippine and Tengchong (China) some of where those prospects has been succes fully in generated electricity since early 1970.

3. Neo-granite Geothermal Concept are composite intrusion batholiths ranging from granite, granodiorite, diorite with sub surface distribution from shallow to deep. This concept can be applied for Kalimantan and Borneo mainland geothermal concept.

4. Neo-granite Geothermal Concept of Kalimantan mainland play important role as a potential heat source and be expected as a comercial potential geothermal reservoir.

5. For the future of AFTA or APEC and in relation to ASEAN cooperation on Electricity Transmission system, development of Kalimantan and Borneo geothermal system is a huge suplementory to the development of others energy resources (hydro, coal, or oil and gas) in Indonesia/Sabah.

6. Besides Kalimantan the concept can be applied for the future geothermal potential finding in Irian Jaya and Papua New Guinea (PNG), Lesser Sunda Island mainland (Nusatenggara) as well as Moluccas archipelagos.

7. The Sabah geothermal area in underline, by volcanic rocks ranging from besalt to anderit and dacete volcanic activity started from early to miocene late quaternary (extrussion on of Besalt).

REFERENCES :

1. P.S. Lim : Geology and Geothermal Potential of the Tawao Area, Jawatan Kaji Bumi, Sabah, Malaysia, ammud report 1987.

2. V.T. Radja ect : Geology, Energy and Development of Indonesia's geothermal Prospects, Symposium of tectonic framework and energy resources of the Western margin of thePasific Basin, Kualalumpur, Nov 29 - Dec 2, 1992.

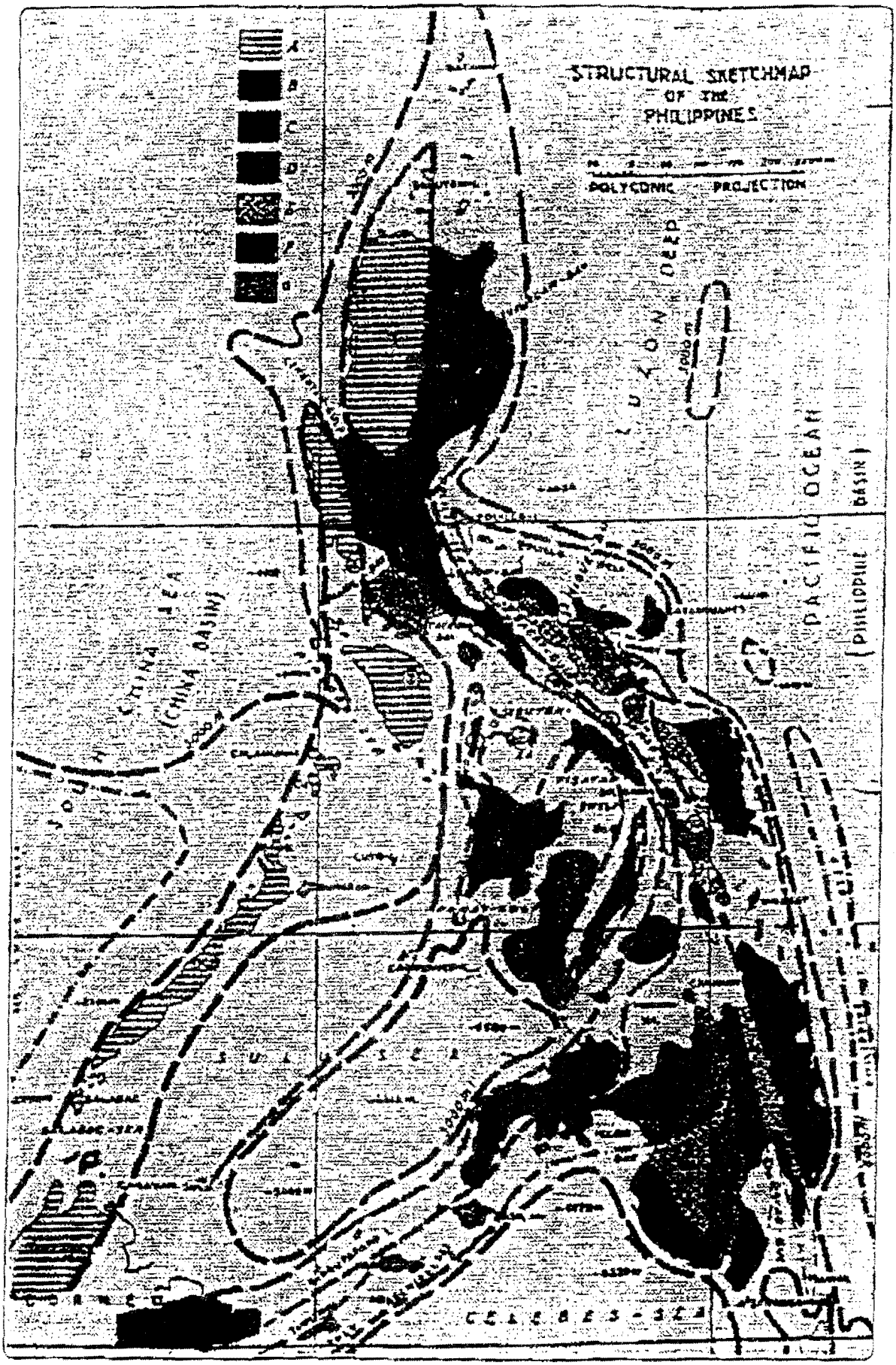
3. IGA : World Geothermal Congress, Florence, Italy, May 1995

4. V.T. Radja : Geothermal prospects in Kalimantan
GRC Portland, OREGON, USA, Oct 4-9, 1996

5. V.T. Radja : Geothermal Pospects in Kalimantan, Borneo Mainland, INAGA, annual meeting, November 1996.

Structural map of Borneo

SKETCH MAP OF iNDONESIA SHOWING THE DISTRIBUTION OF GRANITIC ROCKS AND GEOTHERMAL PROSPECT RELATED TO HOT DRY ROCK (HDR) GEOTHERMAL CONCEPT



Structural sketchmap of the Philippines

GEOTHERMAL CORRELATION BASED ON GESCIENTIFIC SITE EVIDENCES

GEOTHERMAL INDICATION	INDONESIA	MALAYSIA	CHINA	ITALY
1. Location	Tompaso, North Sulawesi 3x20 MW Kerinci, Jambi	Andrassy, Tawao Sabah	Hot Lake, Tengchong Yunnan Province	Lardarello Montamiata
2. Proposed Unit	5 - 20 MW	5 - 15 MW	5 - 50 MW	20 - 50 MW
3. Manifestation	Hot Spring Silica Deposition	Hot Pools Sinter Deposit	Hot Spring Silica Deposition	Silica Deposition Hot Spring
4. Geological Stages	Volcanic Rocks	Metamorphic Rocks	Metamorphic Rocks	Metamorphic Rocks
5. Structure	Tectonic Structure Fault : Kema-Amurang	Extention of Sulawesi Sulu-Philippines Structure	Tectonic and Intrusion	Tectonic and Intrusion
6. Volcanic Activity	Active Volcanoes Soputan, LOKON	Volcanic cones/hills Magdalena, Maria, Luci Worldoof, Kinabalu	Volcanic Foot of Mount Himalaya Extention	Volcanic Extention of Mt Etna, Vesuvius
7. Status	Development Since 1983 Today Under preparation for future development	Under Exploration	Under Exploration	Developed Since 1926

GEOTHERMAL PROJECT CORRELATION BETWEEN INDONESIA, MALAYSIA, CHINA, ITALY WITH SIMILAR PROJECT INDICATION