BUKU PROGRAM

ANNUAL CONFERENCE AND MEETING
PERTEMUAN ILMIAH TAHUNAN
(PIT) XII 2012
Asosiasi Panasbumi indonesia (API) / ndonesia Geothermal Association (INAGA)

Theme : Investing Together to Accelerate The Geothermal Development for The Desire Future Growth

6-8 November 2012
Hotel Grand Royal Panghegar - Bandung

PERTAMINA
GEOTHERMAL ENERGY

Chevron

Secretariat PIT API XII
Wisma Barito Pacific
Star Energy Tower, 9th floor
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DAFTAR ISI

PANITIA PENYELENGGARA PIT API – XII BANDUNG 2012

SUSUNAN ANGGOTA PANITIA PENGARAH DAN PANITIA PELAKSANA PERTEMUAN ILMIAH TAHUNAN (PIT) XII API TAHUN 2012

SK API NOMOR: 001/KEP- PIT XII/PP-API/2012

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Sambutan Ketua pelaksana PIT-XII

Pertama2 atas nama Panitia PIT XII - API, saya mengucapkan selamat datang kepada seluruh peserta PIT di Grand Royal Panghegar Hotel, Bandung.

Panasbumi merupakan sumber energi yang ramah lingkungan dan berpotensi besar untuk dikembangkan di Indonesia. Potensi panasbumi yang dimiliki Indonesia adalah sebesar 27 GWe atau setara dengan sekitar 12 miliar barel minyak bumi (dalam pengoperasian selama 30 tahun). Pada tahun 2025, pemerintah memproyeksikan energi panasbumi untuk pembangkit listrik sekitar 9.500 Mwe

Pertemuan Ilmiah Tahunan XII Asosiasi Panasbumi Indonesia merupakan tanggapan wadah ilmiah dalam rangka menyikapi proyeksi pemerintah tahun 2025. Pertemuan ilmiah ini diselenggarakan pada tanggal 6 – 8 November 2012 di Hotel Grand Royal Panghegar Bandung, dengan mengambil tema "Investing Together To Accelerate Geothermal Development" dengan maksud bahwa untuk mencapai visi pemerintah tersebut baik Jangka pendek, menengah maupun jangka panjang, memerlukan kebersamaan semua pihak, semua stake holder untuk mensukseskan program pengembangan panas bumi hingga mencapai target yang kita harapkan dimasa depan nanti. Agar bisa dipahami bersama bagaimana Investasi panas bumi kedepan nanti, Panitia telah juga menyiapkan 2 sesi panel diskusi, dimana Sesi 1 dengan tema Investing together, dan sesi ke2 dengan tema Geothermal Fund.

Disamping itu Kegiatan yang diselenggarakan meliputi seminar inti dan presentasi ilmiah. Sekitar 90 abstrak telah diterima Panitia dari berbagai kalang, namun pada akhirnya sekitar 75 makalah yang siap dengan oral presentation.

Materi presentasi ilmiah disusun dalam prosiding sebagai hasil kekayaan ilmiah Pertemuan Ilmiah Tahunan XII, Asosiasi Panasbumi Indonesia 2012. Karya Ilmiah ini diharapkan dapat dimanfaatkan oleh perusahaan panasbumi, industri, peneliti, mahasiswa dan lembaga pemerintah.

Akhir kata atas nama Panitia, kami menyampaikan ucapan terima kasih dan penghargaan yang setinggi tingginya, baik kepada para Sponsor yang telah memberikan bantuan, para ekshibitor, serta para ilmuwan yang telah menyumbangkan makalahnya, sehingga acara PIT XII ini bisa terlaksana. Semoga acara ini akan memberikan manfaat kepada semua delegasi konferensi dan peserta pameran.

Salam Panas Bumi,
Atas nama Panitia
Samsul Satar
Ketua Pelaksana.

WATER GEOCHEMICAL ANALYSIS WITHIN PENANTIAN GEOTHERMAL AREA IN PASEMA AIR KERUH KABUPATEN EMPAT LAWANG

F. Virga[1,2], Koryanto[3], Ady Mara[1], Agus S[4], Wahyudi[2], Subarno[2], W. Suryanto[2]

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3. Lampung University
4.Yogyakarta UPN Veteran University

ABSTRACT

Geochemical analyses have been conducted on several samples of water geothermal manifestations are located in the Penantian village, Pasema Air Keruh subdistrict, Empat Lawang district, South Sumatra. Water Geochemic alanalysis use geothermometer, ion balance and geoindicator methods to determine the temperature and the characteristics of thereservoir. From the data processing obtained that the composition of Penantian geothermal water is the sulfate and carbonate types. This indicates that the hot water coming from the volcanic and heat sources are not too deepbelow the surface. While the estimated reservoir temperature above 300°C.

Keywords: Geochemical, geothermal, geothermometer, geoindicator, reservoir.

PROCEEDINGS
The 12TH ANNUAL INDONESIAN GEOTHERMAL ASSOCIATION MEETING & CONFERENCE
Bandung on 6-8 November, 2012

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INTRODUCTION

The Empat Lawang District is located in 3°25'- 4°15' SL and 102°37'- 103°45' EL, **Figure 1**. There are many hot springs with a variety of temperatures ranging up to 93°C (pH 6-7). They are located in the Penantian village of Pasema Air Keruh subdistrict. The country is in the main tectonic belt of Sumatra Fault System and Musi-Keruh Fault, precisely located in the area of active faults and volcanoes.

In regional geology, Empat Lawang district extends along Sumatra Fault System between Bengkulu and South Sumatra provinces. Penantian geothermal field is located near the Bukit Nipis from the Middle Oligocene to early Holocene.

Geothermal area rock types can be seen in **Figure 2**. The country rocks mostly composed of sedimentary rocks of Tertiary age volcanic, including Gumai Formation (Tmg) that composed of calcareous shale, marls, claystones with tuffaceous sandstone and calcareous sandstones intercalations. Then, Seblat Formation (Toms), composed of sandstone containing silicified wood, claystone, conglomeratic sandstone, linestone, shales, marls, tuffaceous claystone with sandstone intercolations [1]. From the geology analysis of the Map Modification Gafoer (1984) can be presumed that the Gumai Formation is a cap rock and Seblat Formation is a reservoir of Penantian geothermal systems.

Based on geological information and data that the surface temperature is relatively high, the Penantian geothermal manifestations is interesting to study further. Among other related to the origin of the hot fluid, characteristic and geothermal temperature reservoir. For that water geochemical surveys have been conducted in the vicinity of manifestation.

The geochemical study is based on discharge water samples collected from the several hot water springs. These samples were collected in June 2012. Chemical analyses of Na, K, Ca, Mg, B, Li, and SO4 were carried out in the laboratory of Lampung University, and the SiO2 Cl, HCO3, in laboratory of Sriwijaya University (Palembang). The results can be seen in **Table 1**.

CHEMICAL CHARACTERIZATION AND TYPE OF HOT WATER

Cl-SO4-HCO3 Diagram

Based on the $Cl\text{-}SO_4\text{-}HCO_3$ triangular diagram (**Figure 3),** plotting of chemical compositions of the hot water samples (Pn, Pn1 and Pn2) lie in stem heated water (in the SO_4 region). It indicates that the classsification of geothermal waters are acid sulfate waters. It means that low in chloride content and occur in volcanic geothermal areas where steam condenses into surface waters. The sulfate content is higly variable in geothermal areas, it is derived from oxidation of hydrogen sulfide in the vadose zone (the subsurface region above the water table) which causes these water to be acid. Geothermal acid sulfate waters form in the shallowest part of the system above the regional water table, therefore they give little indication as to the nature of the deeper part of the system.

While, Pn3 lies in the corner of HCO_3 area. It shows that the water contains low chloride with carbonate as the major anion plus variable sulfate. In systems dominated by volcanic country rocks, carbonate waters typically form in the marginal and shallow subsurface region where CO_2 gas is absorbed and steam is condensed into cool ground water. In contrast to acid sulfate waters, carbonate waters form beneath the water table where they are weakly acidic, but loss of dissolved CO_2 during ascent to surface increases the pH of the natural discharge to neutral or slightly alkaline.

Ion Balance

Tabel 2 shows the values of ion balance of each sample. Samples of hot water (Pn, Pn1 and Pn2) has a value of ion balance more than 5%, except cool water (Pn3). It indicates that the molal concentration does not balance due to volcanic acid water. Ion balance is good to within 5%.

Cl-Li-B Diagram

Cl-Li-B are the most powerful tracer of the origin of the geothermal systems[2]. They are conservative elements in the geothermal system. They are fixed in fluid phase and have not equilibrated. The conservative elements are the best geoindicators for the origin of the geothermal system. B/Cl ratio and Cl-Li-B ternary diagram were used to indicate the source of the fluid. Based on the Cl-Li-B diagram (**Figure 4**), plotting of chemical compositions of the hot water samples are located in the middle of B/Cl line 90 relatively. It indicates that the geothermal water come from the younger hydrothermal systems due to the high absorption of B/Cl steam from the degassing magma[3].

Na-K-Mg Diagram

The Na-K-Mg triangular diagram shows the equilibrium between the geothermal fluids and rock and reservoir temperature (**Figure 5**). In this diagram all the samples have not gained equilibrium with rock, presumably due to fast circulation of fluid through the rock fractures. It causes the water to be immature, considering the ion exchange processes that, equilibrium has not been reached yet with rock minerals because of circulation flow. **Figure 5** shows that samples from studied fall on the full equilibrium line, suggested attainment of reservoar temperature more than 300°C.

SUBSURFACE TEMPERATURE ESTIMATION

Chemical geothermometers are used to estimate the subsurface temperature. Based on the result of Na-K-Mg diagram (the reservoar temperature is more than 300°C), so the chemical geothermometers that used are Na-K (Fournier, 1979[4] and Giggenbach, 1988[5]) and Na-K-Ca (Fournier and Truesdell, 1973[6]). The result can be seen in **Table 2**. Na-K Fournier suggested subsurface temperature in the range 429°C – 439°C. Na-K Giggenbach estimated subsurface ranging from 421°C – 431°C. While, Na-K-Ca gives subsurface temperature about 65°C, it is too low. It indicates that the geothermal water is much more saline than the diluting water.

If we compare, the value obtained from the reservoir temperature diagram with values obtained from geotermometer temperature, it appears that both reservoir temperature above 300°C. This proves there is a good correlation between the two methods above.

CONCLUSION

The results of water geochemical analysis showed the compositions of Penantian geothermal water are the sulfate and carbonate types. This indicates that the hot water coming from the volcanic and heat sources are not too deep below the surface. While, the estimated reservoir temperatures above 300°C.

ACKNOWLEDGEMENTS

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REFERENCES

Gafoer, S., T.C. Amin and R. Pardede: Geological Map Of Bengkulu Quadrangle Sumatra, *Geological Survey Institute*, Bandung, (2007).

Armannsson, H.: Application of Geochemical Methods in Geothermal Exploration, *United Nations University-Kenya Electricity Generating Co., Ltd., Presented at short course II on surface exploration for geothermal resources*, (2007), 1-9.

Mnjokava, T.T.: Interpretation of Exploration Geochemical Data for Geothermal Fluid from The Geothermal Field of The Rungwe Volcanic Area, SW-Tanzania, *United Nations University, Geothermal Training Programme*, Report 2007 No. 14, (2007), 303-332.

Fournier, R. O.: Chemical Geothermometers and Mixing Models for Geothermal System, *Geothermics*, **5**, (1977), 41-50.

Fournier, R., and Truesdell A.: An Empirical Na-K-Ca Geoindicators, *Geochim. Cosmochim. Acta*, **37**, (1973), 1255-1275. Giggenbach, W.: Geothermal Solute Equilibria. Derivation of Na-K-Mg-Ca Geoindicators, *Geochim. Cosmochim. Acta*, **52**, (1988), 2749-2765.

Giggenbach, W.F.: Chemical Techniques in Geothermal Exploration. In: D'Amore, F(coordinator), *Application of geochemistry in geothermal reservoir development.* UNITAR/UNDP publication, Rome, (1988), 119-142.

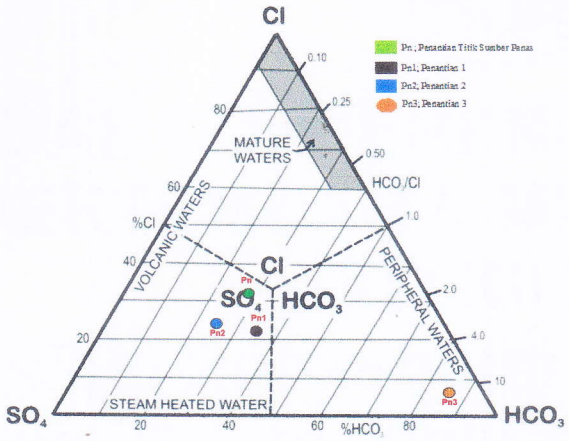

Fig. 3. Cl-SO_4-HCO_3 Diagram

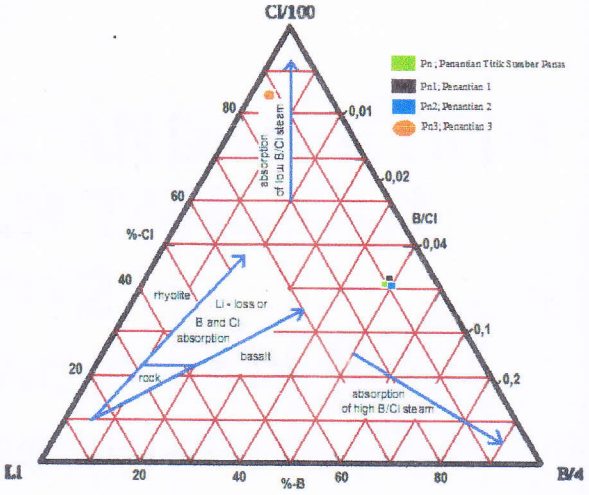

Fig. 5. Cl-Li-B Diagram

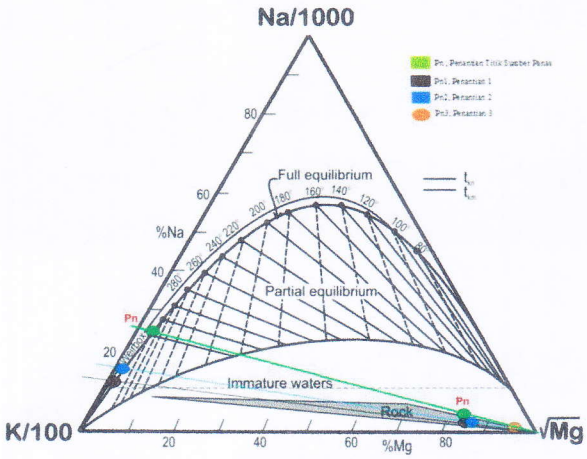

Fig. 4. Na-K-Mg Diagram