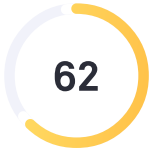
176-1124-1-CE

by Rahmat Catur Wibowo

General metrics

19,952	2,951	198	11 min 48 sec	22 min 42 sec
characters	words	sentences	reading time	speaking time

Score



This text scores better than 62% of all texts checked by Grammarly

Writing Issues

189	92	97
Issues left	Critical	Advanced

Plagiarism

This text hasn't been checked for plagiarism

Writing Issues

119	**Correctness**	
28	Misspelled words	
2	Text inconsistencies	
27	Determiner use (a/an/the/this, etc.)	
13	Wrong or missing prepositions	
13	Punctuation in compound/complex sentences	
5	Comma misuse within clauses	
4	Incorrect noun number	
12	Incorrect verb forms	
4	Misplaced words or phrases	
4	Incomplete sentences	
3	Improper formatting	
3	Faulty subject-verb agreement	
1	Faulty tense sequence	
64	**Clarity**	
24	Passive voice misuse	
12	Unclear sentences	
15	Wordy sentences	
4	Hard-to-read text	
3	Intricate text	
6	Unclear paragraphs	
3	**Delivery**	
3	Inappropriate colloquialisms	
3	**Engagement**	

3 Word choice

Unique Words

Measures vocabulary diversity by calculating the percentage of words used only once in your document

22%

unique words

Rare Words

Measures depth of vocabulary by identifying words that are not among the 5,000 most common English words.

39%

rare words

Word Length

Measures average word length

4.4

characters per word

Sentence Length

Measures average sentence length

14.9

words per sentence

176-1124-1-CE

JGE (Jurnal Geofisika Eksplorasi) XX (XXXX) XXXXXX Author et al

JGE (Jurnal Geofisika Eksplorasi) XX (XXXX) XXXXXX Author et al

3

1

JGE (Jurnal Geofisika Eksplorasi)

Vol. xx No. xx, xxxxxx xxx (xxx-xxx) https://doi.org/XXXX/XXXX

1

SUBSURFACE SURVEY OF CISARUA LAMPUNG HOT SPRINGS BY USING GEOCHEMICAL AND GRADIO-MAGNETIC METHOD

SURVEI BAWAH PERMUKAAN MATAAIR PANAS CISARUA LAMPUNG DENGAN MENGGUNAKAN METODE GEOKIMIA DAN GRADIO-MAGNETIK

xxx

xxx

Received: xxxx-xx-xx Accepted: xx-xx-xx

Keywords:

Cisarua Hot Springs;

South Lampung;

Geochemical;

Geological;
Gradio-magnetic.

Corespondent Email:
xxx

How to cite this article:
xxx (2022). Subsurface Survey of Cisarua Lampung Hot Springs by Using Geochemical and Gradio-magnetic Method. Jurnal Geofisika Eksplorasi, 6(2), 156-168.

Abstract. This research was conducted in the Cisarua Hot Springs, South Lampung. The Cisarua Hot Springs has temperature about 44 °C and neutral pH. The purpose of this research is to identify the characteristics of the Cisarua Hot Springs, estimate the reservoir temperature, and make a subsurface model of the study area. The method used is geochemistry and gradio-magnetic method. From geological data, the manifestation of this hot springs is interpreted to be in the Lampung-Panjang Fault. Geochemical results show that this type of hot springs fluid is bicarbonate water and the estimated reservoir temperature is around 160 °C. Based on the 3D model of the gradio-magnetic method, it is interpreted that the distribution of subsurface hot water flow is associated with low gradio-magnetic anomaly. The area of subsurface hot fluids distribution is in the middle to the east part of the study area.

Abstrak. Penelitian ini dilakukan di sekitar Mataair Panas Cisarua, Lampung Selatan. Mataair Panas Cisarua ini memiliki suhu sekitar 44 °C dan pH netral.

Tujuan dari penelitian ini adalah untuk mengidentifikasi karakteristik Mataair Panas Cisarua, memperkirakan suhu reservoir, dan membuat model bawah permukaan daerah penelitian. Metode yang digunakan adalah metode geokimia dan gradio-magnetic. Dari data geologi, manifestasi mataair panas ini diinterpretasikan berasosiasi dengan Sesar Lampung-Panjang. Hasil geokimia menunjukkan bahwa tipe fluida mataair panas ini adalah air bikarbonat dan estimasi suhu reservoir sekitar 160 °C. Berdasarkan model 3D metode gradio-magnetic, diinterpretasikan bahwa sebaran aliran air panas bawah permukaan berhubungan dengan anomali gradio-magnetic rendah. Daerah sebaran fluida panas bawah permukaan berada di bagian tengah hingga timur daerah penelitian.

INTRODUCTION

Indonesia has considerable geothermal potential. Based on a recent survey from the Center for Mineral, Coal and Geothermal Resources, the Geological Agency of the Ministry of Energy and Mineral Resources, 331 potential areas have been identified consisting of resource about 11073 MW and reserve about 17506 MW spread across 30 provinces (Kementerian ESDM, 2017). Then on the Sumatra Island, there are about 93 geothermal potential areas spread from Aceh to Lampung. One of area that has geothermal potential is Cisarua, South Lampung Regency, Lampung Province.

There are some researchs about geothermal studies that have been carried out in Lampung such as Hussein et al. (2015) about tectonic control to geothermal system of Way Panas, Lampung. This geothermal field associated with the

active Sumatera Fault Zone. Permatasari et al. (2019) conducted gravity modeling in the Rendingan-Ulubelu-Way Panas Geothermal Field Area, Lampung. The results showed that the high anomaly under Mount Way Panas was interpreted as a tertiary intrusion of granite rocks and the low anomaly in the northern part was interpreted as a quarter diorite intrusion, which was interpreted as a heat source. Iqbal et al. (2019a) about delineation of recharge and discharge area in Natar Geothermal System. The result showed that the recharge area of the Natar Hot Springs is located in the Western and Southern parts of the Metro-Kotabumi Groundwater Basin. Iqbal et al. (2019b) conducting research on hydrogeochemistry of Natar Hot Springs. Natar Reservoir has a temperature of 120-140°C with a depth of 285-400 m and geothermal discharge of Natar has undergone water-rock interaction with metamorphic carbonate/ marble under the surface. Santoso et al. (2020a) identify the flow of hot water in Natar, Lampung. The results obtained are the hot water flows from the gradiometer high anomaly area to the low anomaly area.

The research location is in the Cisarua Area, South Lampung Regency. One of indication the presence of geothermal in this area is the discovery of geothermal manifestations in the form of hot springs. So far, research conducted in this area is still rare, one of them was done by Suharno et al. (2012) through geological observation. The results stated the presence of hot water that appears on the surface through structures such as faults and fissures is related to the geological state of the Cisarua region which correlates with the Lampung-Panjang Fault. Because research in this area is very limited, researchers want to conduct research using geochemical and gradio-magnetic methods. The purpose of this study is to identify the characteristics of the Cisarua Hot Springs, estimate the reservoir temperature, and make a

subsurface model of the study area to determine the distribution of subsurface hot fluid.

LITERATURE REVIEW

2.1 Regional Geology

Regional geology of Tanjung Karang Area already mapped by Mangga et al. (1993) and showed by Figure 1. Based on the geological map (Mangga et al., 1993), the bedrock geology in this area was composed by sedimentation of swamps, alluvial, young deposit volcanoes, Lampung Formation, Hulusimpang Formation, Sabu Formation, Tarahan Formation, Menanga Formation, unconsolidated Gunung Kasih Complex, Way Galih Schist, Dacite Joining, and Dulan Granodiorite.

From the geological map, the regional stratigraphy in this area is composed by rocks from the Pre-Tertiary, Tertiary, and Quaternary deposits. The tertiary structure comprising the oldest rocks of low-medium metamorphic rock, consisting of schist, gneis, marble, quartzite, and also Gunungkasih Complex. The Gunungkasih Complex consists of schist, graphical pelitic quartz, marble, limestone schist and orthogenes. Assuming that this lithological distribution reflects the complex geological state, there is a strong suspicion that the igneous rock formation is the remnants of the Paleozoic magma arc and the remnants of the trench sediment or the groundwater associated with the arc. The research location is in the Cisarua Area, South Lampung Regency, Lampung Province. The location of hot springs in the study area can be seen in Figure 2. Based on the geological map dan prelimary research by Suharno et al. (2012), the manifestation of the Cisarua Hot Springs is interpreted to be on the Lampung-Panjang Fault that has a Northwest-Southeast direction. Old Hot Springs are no longer active due to drilling in Young Hot Springs. Based on

direct observations in the field and previous research (Suharno et al., 2012), it shows that the Old Cisarua Hot Springs has travertine sintered deposits with a diameter of about 12 m. Whereas Young Hot Springs have a diameter of about 1.5 m. There is also sintered travertine deposit around the manifestation of this hot springs.

2.2 Geothermal Systems

Du et al. (2005) conducted research on variations of geothermometry and chemical-isotopic compositions of hot spring fluids in the Rehai Geothermal Field, Southwestern China. Based on various geothermometers, estimated temperatures of the geothermal reservoirs are from 69 °C to 450 °C and estimated of subsurface reservoir temperature 250–300 °C. This result also showed contributions of mantle fluids and shallow crust fluids in Rehai Geothermal Field varied with time, which associated with variations of chemical and isotopic compositions and reservoir temperatures. Alam et al. (2019) conducted research on hydrogeochemistry and isotopic characteristics at the Cidanau Geothermal Field, Indonesia. The result showed geothermal waters were identified mainly as Na-Cl-HCO3 type of water and pH of the waters was close to neutral. The temperature of the hot-water discharges varied from 32.2 °C to 61.1 °C. The result also showed a conceptual model of the Cidanau Geothermal Field Hot Springs.

Purnomo and Pichler (2014) about geothermal systems in Java, including identify water chemistry to determine the temperature of geothermal reservoirs. The result also showed that the geothermal system in Java was affected by faults system. A year later Purnomo and Pichler (2015) conducted research on the geothermal system on the Bali Island.

DiFrancesco et al. (2012) reviewed gravity gradiometry in non-traditional applications. Modeling and analysis scenarios where gravity and gradiometry may detection and characterization of aquifers, monitoring of CO2 storage sites, geothermal exploration, and enhanced oil recovery monitoring.

METHODS

The method used in this study is a combination of geochemical and gradio-magnetic methods. Geochemical survey is carried out by mapping coordinates and taking water samples directly into the Cisarua Hot Springs. Geochemical analysis is carried out based on laboratory tests, namely using Atomic Absorption Spectrometry Method. Atomic absorption spectrometry (AAS) is a technique in which free gaseous atoms absorb electromagnetic radiation at a specific wavelength to produce a corresponding measurable signal (Ivanova, 2005). The absorption signal is proportional to the concentration of the free atoms present in the optical path (Ivanova, 2005).

The elements tested include Na, K, Ca, Mg, Cl, SO4, and HCO3. Then the geochemical data is processed and plotted on a ternary diagram to determine the type of hot spring and reservoir temperature estimation. The geothermometer used to estimate the subsurface temperature is the Geothermometer Na-K-Mg (Giggenbach, 1991) using equation (1) for the neutral chlorite water. Then used a Geothermometer K-Mg that has been modified for the bicarbonate water with equation (2). Equations (1) and (2) can be seen as follow:

t°C=1390logNaK+1.75-273 (1)

t°C=441014-logK2Mg-273 (2)

Measurement of the gradio-magnetic method is carried out using a magnetometer with a gradiometer combination. Basically the gradio-magnetic method, include acquisition, processing, and interpretation data is similar to the magnetic method. The difference lies in the number of sensors used. Measurements with two sensors aim to reduce daily variations. Measurements using two magnetometer sensors so that the difference in measurements from the two measurement sensors can be seen. Concept of magnetic force F (Telford et al., 1990) given by Coulomb's law:

F=p1p2μr2r1(3)

where F is the force on p2, the poles of strength p1 and p2 are r apart, μ is the magnetic permeability, and r1 is a unit vector directed from p1 toward p2 (Telford et al., 1990).

Gradio-magnetic surveys according the gradient of F is usually calculated from the magnetic contour map. There is considerable merit in measuring the vertical gradient directly in the field (Telford et al., 1990). It is merely necessary to record two readings, one above the other. Then the vertical gradient is given by:

ðFðz=F2-F1Δz(4)

where F2 and F1 are readings at the higher and lower elevations, and Δz is the separation distance (Telford et al., 1990).

The gradio-magnetic survey was conducted in the Cisarua Area with a survey design as shown in Figure 3. The measurement with a gradio-magnetic was

carried out as many as 93 measurement stations with a distance between stations of 25 m around the Cisarua Hot Springs with an area about 39375 m2. The separation of two magnetometer sensors about 1 m. Then the gradio-magnetic data is processed to create a subsurface model of the study area.

RESULTS AND DISCUSSION

The coordinates of the Old Cisarua Hot Springs are at UTM-X 525897 m and UTM-Y 9413036 m. While the coordinates of the Young Cisarua Hot Springs are at UTM-X 526037 m and UTM-Y 9412891 m. Based on direct observations and measurements in the field, it was found that temperature of the Cisarua Hot Springs is about 44 °C and has a neutral pH. The results of water chemistry analysis in Cisarua sample is presented in Table 1. There is only one active fluid manifestation in the Cisarua Area, namely the Young Cisarua Hot Springs. While the Old Cisarua Hot Springs, the fluid manifestations have dried up and there are only visible traces of sintered travertine.

The results of geochemical data processing can be seen in Figure 4 and Figure 5. Based on the Cl-SO4-HCO3 ternary diagram (Giggenbach, 1991) in Figure 4, the Cisarua Hot Springs type is bicarbonate water. This result is also valid with Iqbal et al. (2019b) research. This is interpreted that the fluid has been interactions with rocks near the subsurface or shallow subsurface (Nicholson, 1993). This is also evident from the sintered travertine deposits found around the hot springs. Then based on the Na-K-Mg ternary diagram (Giggenbach, 1991) that has been modified (bicarbonate water type) in Figure 5, the estimated reservoir temperature of the study area is 160 °C.

The results of the processing of the gradio-magnetic data can be seen in Figure 6 and Figure 7. Based on Figure 6, it can be seen that the hot springs of the study area are at the low anomaly gradio-magnetic. Then the 3D low anomaly

gradio-magnetic modeling results are shown in Figure 7. From that modeling obtained depth about 135 m and show that low anomaly distribution of the gradio-magnetic. Magnetic or gradio-magnetic anomalies are useful in the delineation of geothermal systems because hydrothermal processes can significantly reduce the rock magnetization either through thermal demagnetization or by the alteration of magnetic minerals to less magnetic minerals (Tontini et al., 2016). So we can conclude that hot objects or fluids will be demagnetize or lose their magnetic properties. It is therefore interpreted that the low gradio-magnetic anomaly is associated with subsurface hot fluid distribution. The area of subsurface fluid distribution is in the middle to east part of the study area.

From the 3D gradio-magnetic modeling and geochemistry results, the distribution of bicarbonate hot fluid is shallow or obtained at a depth of 20 to 135 m. From gradio-magnetic results is showed similar results to previous studies conducted by Santoso et al (2020b), which states has a distribution of hot water in center and southeast research area.

The research only focuses on the Cisarua Hot Springs by using a magnetometer with a gradiometer. Furthermore, it is necessary to carry out more extensive measurements. And also to ensure the existence of a shallow reservoir in the study area, it is necessary to carry out further research studies such as Magnetotelluric (MT) method and drilling.

CONCLUSION

Geochemical results show that the Cisarua type of Hot Springs is bicarbonate water and the estimated reservoir temperature is around 160 °C.

The gradio-magnetic results show that the distribution of subsurface hot fluids is in the middle to the east part of the study area.

ACKNOWLEDGMENT

The author thanks to ITERA SMART Awardee for the research funding.

REFERENCES

Alam, B., Itoi, R., Taguchi, S., Saibi, H., Yamashiro, R. (2019). Hydrogeochemical and Isotope Characterization of Geothermal Waters from the Cidanau Geothermal Field, West Java, Indonesia. Geothermics, 78, 62-69.

Direktorat Panas Bumi Energi Sumber Daya Mineral. (2017). Potensi Panas Bumi Indonesia Jilid 1. Jakarta: Kementerian ESDM.

Du, J., Liu, C., Fu, B., Ninomiya, Y., Zhang, Y., Wang, C., Wang, H., Sun, Z. (2005). Variations of Geothermometry and Chemical-isotopic Compositions of Hot Springs Fluids in the Rehai Geothermal Field, Southwestern China. Journal of Volcanology and Geothermal Research, 142, 243– 261.

DiFrancesco, D., Kohrn B., Bonet, C., Gibson, H. (2012). Gravity Gradiometry for Emerging Applications, ASEG Extended Abstracts, 1-4. https://doi.org/10.1071/ASEG2012ab123

Giggenbach, W.F. (1991). Chemical Techniques in Geothermal Exploration: In Application of Geochemistry in Geothermal Reservoir Development. (F. D'Amore, co-ordinator), UNITAR, 119-144.

Husein, S., Setianto, A., Nurseto, S.T., Koestono, H. (2015). Tectonic Control to Geothermal System of Way Panas, Lampung, Indonesia. Conference: World Geothermal Congress. http://dx.doi.org/10.13140/RG.2.1.1228.3605

Iqbal, M., Juliarka, B.R., Ashuri, W., Farishi, B.A, Harbowo, D.G. (2019a). Delineation of Recharge and Discharge Area for Geothermal Energy in Natar. IOP Conference Series: Earth and Environmental Science. 258. https://doi:10.1088/1755-1315/258/1/012036

Iqbal, M., Juliarka, B.R., Ashuri, W., Farishi, B.A. (2019b). Hydrogeochemistry of Natar and Cisarua Hot Springs in South Lampung, Indonesia. Journal of Geoscience, Engineering, Environment, and Technology, Vol 04 No 03. https://DOI: 10.25299/jgeet.2019.4.3.4070

Ivanova, E.H. (2005). Encyclopedia of Analytical Science Second Edition. Elsevier Ltd., 149-156.

Mangga, S.A., Amirudin, Suwarti, T., Gafoer, S., Sidarto. (1993). Peta Geologi Lembar Tanjungkarang, Sumatera skala 1:250.000

Nicholson, K. (1993). Geothermal Fluids. Springer Berlin Heidelberg, Berlin, Heidelberg.

Permatasari, A.W., Santoso, J., Setianingsih. (2019). Subsurface Modeling Based on Gravity Data of Rendingan-Ulubelu-Waypanas (RUW) Geothermal Field, Lampung, Indonesia. IOP Conference Series: Earth and Environmental Science, 318. https://doi:10.1088/1755-1315/318/1/012002

Purnomo, B.J., Pichler, T. (2014). Geothermal Systems on the Island of Java, Indonesia. Journal of Volcanology and Geothermal Research, 285, 47-59.

Purnomo, B.J., Pichler, T. (2015). Geothermal Systems on the Island of Bali, Indonesia. Journal of Volcanology and Geothermal Research, 304, 349-358.

Santoso, N.A., Rizki, R., Hakim, R.A., Ashuri, W., Paembonan, A.Y., Zulaikah, S. (2020a). Geothermal Studies to Identify the Flow of Hot Water in Natar, Lampung using Gradiometer. AIP Conference Proceedings 2251. https://doi.org/10.1063/5.0015796

Santoso, N.A., Rizki, R., Hakim, R.A., Ashuri, W., (2020b). Identification Distribution of Hot Spring in Cisarua Using Magnetic Method. IOP Conf. Series: Earth and Environmental Science 537. https://doi:10.1088/1755-1315/537/1/012006

Suharno, Aritonang, R.B., Zainudin, A., Rustadi. (2012). Sistem Panas Bumi Cisarua Natar, Lampung Selatan. Presented at The 12th Annual Indonesian Geothermal Association Meeting & Conference, Bandung.

Telford, W. M., Geldart, L. P., Sheriff, R. E. (1990). Applied Geophysics Second Edition. Cambridge University Press. https://doi.org/10.1017/CBO9781139167932

Tontini, F.C., de Ronde, C.E.J., Scoot, B.J., Soengkono, S., Stagpoole, V., Timm, C., Tivey, M. (2016). Interpretation of Gravity and Magnetic Anomalies at Lake Rotomahana: Geological and Hydrothermal Implications. Journal of Volcanology and Geothermal Research, 314, 84-94.

Figure 1. Geological Map of Tanjung Karang (Modified from Mangga et al., 1993)

Figure 2. Map of Cisarua Hot Springs and Its Surrounding

Figure 3. Design of the Cisarua Gradio-magnetic Survey

Figure 4. Type of Hot Spring Research Area (Modified from Giggenbach, 1991)

Figure 5. Estimation of Reservoir Temperature in Research Area (Modified from Giggenbach, 1991)

Figure 6. Gradio-magnetic Data Processing Result

Figure 7. Results of 3D Low Anomaly Gradio-magnetic Modeling of Research Area

Table 1. Water Chemistry Result

No

Sample Code

pH

T

Na

K

Ca

Mg

Cl

SO4

HCO3

C

ppm

ppm

ppm

ppm

ppm

ppm

ppm

1

Cisarua

Ci

7

44

826

87

12.4

1.3

601

160

1297

1.	~~Gradio~~ → Grade, Radio	Misspelled words	Correctness
2.	*. Subsurface; . This; . The; . From; . Geochemical; . Based; . Then; . One; . Permatasari; . Iqbal; . Natar; . So; . Because; . Assuming; . Old; . Whereas; . There; . Alam; . A; . Modeling; . Geochemical; . Atomic; . Equations; . Basically; . Measurements; . Concept; . It; . While; . Magnetic; . F...*	Text inconsistencies	Correctness
3.	*was conducted*	Passive voice misuse	Clarity
4.	a temperature	Determiner use (a/an/the/this, etc.)	Correctness
5.	of about	Wrong or missing prepositions	Correctness
6.	*The purpose of this research is to identify the characteristics of the Cisarua Hot Springs, estimate the reservoir temperature, and make a subsurface model of the study area.*	Unclear sentences	Clarity
7.	~~gradio~~ → radio	Misspelled words	Correctness
8.	the gradio-magnetic	Determiner use (a/an/the/this, etc.)	Correctness
9.	~~this hot~~ → these hot	Determiner use (a/an/the/this, etc.)	Correctness
10.	*is interpreted*	Passive voice misuse	Clarity
11.	, and	Punctuation in compound/complex sentences	Correctness
12.	~~gradio~~ → radio	Misspelled words	Correctness
13.	*is interpreted*	Passive voice misuse	Clarity
14.	the low	Determiner use (a/an/the/this, etc.)	Correctness

15.	~~gradie~~ → grade	Misspelled words	Correctness
16.	*The area of subsurface hot fluids distribution is in the middle to the east part of the study area.*	Unclear sentences	Clarity
17.	, and	Comma misuse within clauses	Correctness
18.	*been identified*	Passive voice misuse	Clarity
19.	~~resource~~ → resources	Incorrect noun number	Correctness
20.	of about	Wrong or missing prepositions	Correctness
21.	~~reserve~~ → reserves	Incorrect noun number	Correctness
22.	of about	Wrong or missing prepositions	Correctness
23.	~~the~~ Sumatra	Determiner use (a/an/the/this, etc.)	Correctness
24.	~~of~~	Wrong or missing prepositions	Correctness
25.	the area, or an area	Determiner use (a/an/the/this, etc.)	Correctness
26.	~~area~~ → areas	Incorrect noun number	Correctness
27.	~~of area that has~~ → area with	Wordy sentences	Clarity
28.	~~researchs~~ → research, researches	Misspelled words	Correctness
29.	*been carried out*	Passive voice misuse	Clarity
30.	, such	Punctuation in compound/complex sentences	Correctness
31.	the geothermal, or a geothermal	Determiner use (a/an/the/this, etc.)	Correctness
32.	is associated	Incorrect verb forms	Correctness

33.	*was interpreted*	Passive voice misuse	Clarity
34.	, and	Punctuation in compound/complex sentences	Correctness
35.	~~and the~~ → . The	Hard-to-read text	Clarity
36.	*was interpreted*	Passive voice misuse	Clarity
37.	the delineation	Determiner use (a/an/the/this, etc.)	Correctness
38.	*is located*	Passive voice misuse	Clarity
39.	~~conducting~~ → conducted	Incorrect verb forms	Correctness
40.	researching	Wordy sentences	Clarity
41.	~~Natar~~ → Near	Misspelled words	Correctness
42.	, and	Punctuation in compound/complex sentences	Correctness
43.	the geothermal	Determiner use (a/an/the/this, etc.)	Correctness
44.	~~of~~	Wordy sentences	Clarity
45.	~~of indication~~ → indication of	Misplaced words or phrases	Correctness
46.	~~, one~~ → ; one, . One	Punctuation in compound/complex sentences	Correctness
47.	*was done*	Passive voice misuse	Clarity
48.	that the	Inappropriate colloquialisms	Delivery
49.	that the	Inappropriate colloquialisms	Delivery

50.	, which	Punctuation in compound/complex sentences	Correctness
51.	~~very limited~~ → minimal	Word choice	Engagement
52.	~~gradio~~ → radio, grade	Misspelled words	Correctness
53.	~~to~~	Incorrect verb forms	Correctness
54.	~~subsurface hot~~ → hot subsurface	Misplaced words or phrases	Correctness
55.	The regional	Determiner use (a/an/the/this, etc.)	Correctness
56.	the Tanjung	Determiner use (a/an/the/this, etc.)	Correctness
57.	is already	Incorrect verb forms	Correctness
58.	~~showed~~ → shown	Incorrect verb forms	Correctness
59.	~~by~~ → in	Wrong or missing prepositions	Correctness
60.	~~by~~ → of	Wrong or missing prepositions	Correctness
61.	~~Menanga~~ → Manga	Misspelled words	Correctness
62.	*Based on the geological map (Mangga et al., 1993), the bedrock geology in this area was composed by sedimentation of swamps, alluvial, young deposit volcanoes, Lampung Formation, Hulusimpang Formation, Sabu Formation, Tarahan Formation, Menanga Formation, unconsolidated Gunung Kasih Complex, Way Ga...*	Hard-to-read text	Clarity
63.	~~by~~ → of	Wrong or missing prepositions	Correctness
64.	*From the geological map, the regional stratigraphy in this area is composed by rocks from the Pre-Tertiary, Tertiary, and Quaternary deposits.*	Unclear sentences	Clarity

65.	~~comprising~~ → comprises	Incorrect verb forms	Correctness
66.	~~gneis~~ → gneiss	Misspelled words	Correctness
67.	*The tertiary structure comprising the oldest rocks of low-medium metamorphic rock, consisting of schist, gneis, marble, quartzite, and also Gunungkasih Complex.*	Unclear sentences	Clarity
68.	, and	Comma misuse within clauses	Correctness
69.	~~orthogenes~~ → orthogenesis	Misspelled words	Correctness
70.	~~Lampung~~	Wordy sentences	Clarity
71.	*be seen*	Passive voice misuse	Clarity
72.	~~prelimary~~ → preliminary	Misspelled words	Correctness
73.	*is interpreted*	Passive voice misuse	Clarity
74.	~~that has~~	Wordy sentences	Clarity
75.	~~Whereas~~ → At the same time,, In contrast,, In comparison,	Incomplete sentences	Correctness
76.	~~this hot~~ → these hot	Determiner use (a/an/the/this, etc.)	Correctness
77.	researched	Wordy sentences	Clarity
78.	the estimated	Determiner use (a/an/the/this, etc.)	Correctness
79.	, and	Comma misuse within clauses	Correctness
80.	the estimated	Determiner use (a/an/the/this, etc.)	Correctness
81.	~~of~~	Wrong or missing prepositions	Correctness

82.	~~of~~	Wordy sentences	Clarity
83.	is 250	Incorrect verb forms	Correctness
84.	was associated	Incorrect verb forms	Correctness
85.	researched	Wordy sentences	Clarity
86.	, and	Punctuation in compound/complex sentences	Correctness
87.	the pH	Determiner use (a/an/the/this, etc.)	Correctness
88.	~~identify~~ → identifying	Incorrect verb forms	Correctness
89.	*Purnomo and Pichler (2014) about geothermal systems in Java, including identify water chemistry to determine the temperature of geothermal reservoirs.*	Incomplete sentences	Correctness
90.	the faults	Determiner use (a/an/the/this, etc.)	Correctness
91.	later,	Punctuation in compound/complex sentences	Correctness
92.	researched	Wordy sentences	Clarity
93.	~~the~~ Bali	Determiner use (a/an/the/this, etc.)	Correctness
94.	*may*	Incomplete sentences	Correctness
95.	*Modeling and analysis scenarios where gravity and gradiometry may detection and characterization of aquifers, monitoring of CO2 storage sites, geothermal exploration, and enhanced oil recovery monitoring.*	Unclear sentences	Clarity

96.	~~gradio~~ → radio, grade	Misspelled words	Correctness
97.	The geochemical, or A geochemical	Determiner use (a/an/the/this, etc.)	Correctness
98.	The geochemical, or A geochemical	Determiner use (a/an/the/this, etc.)	Correctness
99.	~~namely~~	Wordy sentences	Clarity
100.	~~the Geothermometer~~	Wordy sentences	Clarity
101.	~~that has been~~	Wordy sentences	Clarity
102.	*been modified*	Passive voice misuse	Clarity
103.	*be seen*	Passive voice misuse	Clarity
104.	~~gradio~~ → radio	Misspelled words	Correctness
105.	*is carried out*	Passive voice misuse	Clarity
106.	*Measurement of the gradio-magnetic method is carried out using a magnetometer with a gradiometer combination.*	Unclear sentences	Clarity
107.	Basically,	Comma misuse within clauses	Correctness
108.	~~Basically~~ the	Wordy sentences	Clarity
109.	~~gradio~~ → radio, grade	Misspelled words	Correctness
110.	~~include~~ → including	Incorrect verb forms	Correctness
111.	the acquisition	Determiner use (a/an/the/this, etc.)	Correctness
112.	of data	Wrong or missing prepositions	Correctness
113.	*Basically the gradio-magnetic method, include acquisition, processing, and*	Unclear sentences	Clarity

	interpretation data is similar to the magnetic method.		
114.	*be seen*	Passive voice misuse	Clarity
115.	~~where~~ → Where	Improper formatting	Correctness
116.	~~Gradio~~ → Grade, Radio	Misspelled words	Correctness
117.	according to	Wrong or missing prepositions	Correctness
118.	~~is~~ → are	Faulty subject-verb agreement	Correctness
119.	*is usually calculated*	Passive voice misuse	Clarity
120.	~~directly in~~ → directly in	Improper formatting	Correctness
121.	~~where~~ → Where	Improper formatting	Correctness
122.	~~gradio~~ → radio, grade	Misspelled words	Correctness
123.	, as	Punctuation in compound/complex sentences	Correctness
124.	*The measurement with a gradio-magnetic was carried out as many as 93 measurement stations with a distance between stations of 25 m around the Cisarua Hot Springs with an area about 39375 m2.*	Intricate text	Clarity
125.	~~gradio~~ → radio, grade	Misspelled words	Correctness
126.	of about	Wrong or missing prepositions	Correctness
127.	is about	Incorrect verb forms	Correctness
128.	~~gradio~~ → radio	Misspelled words	Correctness
129.	*The coordinates of the Old Cisarua Hot Springs are at UTM-X 525897 m and*	Unclear sentences	Clarity

	UTM-Y 9413036 m.		
130.	~~While~~ → At the same time,, In contrast,, In comparison,	Incomplete sentences	Correctness
131.	*The coordinates of the Old Cisarua Hot Springs are at UTM-X 525897 m and UTM-Y 9413036 m. While the coordinates of the Young Cisarua Hot Springs are at UTM-X 526037 m and UTM-Y 9412891 m.*	Unclear paragraphs	Clarity
132.	*was found*	Passive voice misuse	Clarity
133.	~~it was found that~~ → the	Wordy sentences	Clarity
134.	the temperature	Determiner use (a/an/the/this, etc.)	Correctness
135.	the Cisarua	Determiner use (a/an/the/this, etc.)	Correctness
136.	~~is~~ → are	Faulty subject-verb agreement	Correctness
137.	*is presented*	Passive voice misuse	Clarity
138.	, and	Punctuation in compound/complex sentences	Correctness
139.	*While the Old Cisarua Hot Springs, the fluid manifestations have dried up and there are only visible traces of sintered travertine.*	Unclear sentences	Clarity
140.	*be seen*	Passive voice misuse	Clarity
141.	*Based on the Cl-SO4-HCO3 ternary diagram (Giggenbach, 1991) in Figure 4, the Cisarua Hot Springs type is bicarbonate water.*	Unclear sentences	Clarity
142.	~~al.~~ → al.'s	Incorrect noun number	Correctness

143.	*This*	Intricate text	Clarity
144.	*is interpreted*	Passive voice misuse	Clarity
145.	*This*	Intricate text	Clarity
146.	*been modified*	Passive voice misuse	Clarity
147.	processing results	Wordy sentences	Clarity
148.	~~gradio~~ → radio	Misspelled words	Correctness
149.	*be seen*	Passive voice misuse	Clarity
150.	*be seen*	Passive voice misuse	Clarity
151.	~~the low~~ → a low	Determiner use (a/an/the/this, etc.)	Correctness
152.	~~gradio~~ → radio, grade	Misspelled words	Correctness
153.	~~gradio~~ → radio, grade	Misspelled words	Correctness
154.	, modeling	Punctuation in compound/complex sentences	Correctness
155.	a depth	Determiner use (a/an/the/this, etc.)	Correctness
156.	of about	Wrong or missing prepositions	Correctness
157.	~~show~~ → showed	Faulty tense sequence	Correctness
158.	~~gradio~~ → radio	Misspelled words	Correctness
159.	~~gradio~~ → radio, grade	Misspelled words	Correctness
160.	~~useful~~ → helpful	Word choice	Engagement
161.	~~less~~ → more minor	Word choice	Engagement

162.	*Magnetic or gradio-magnetic anomalies are useful in the delineation of geothermal systems because hydrothermal processes can significantly reduce the rock magnetization either through thermal demagnetization or by the alteration of magnetic minerals to less magnetic minerals (Tontini et al., 2016).*	Unclear sentences	Clarity
163.	~~be demagnetize~~ → be demagnetized	Incorrect verb forms	Correctness
164.	*is therefore interpreted*	Passive voice misuse	Clarity
165.	~~gradio~~ → grade, radio	Misspelled words	Correctness
166.	*It is therefore interpreted that the low gradio-magnetic anomaly is associated with subsurface hot fluid distribution.*	Unclear sentences	Clarity
167.	the east	Determiner use (a/an/the/this, etc.)	Correctness
168.	~~gradio~~ → radio, grade	Misspelled words	Correctness
169.	~~bicarbonate hot~~ → hot bicarbonate	Misplaced words or phrases	Correctness
170.	*From the 3D gradio-magnetic modeling and geochemistry results, the distribution of bicarbonate hot fluid is shallow or obtained at a depth of 20 to 135 m.*	Hard-to-read text	Clarity
171.	~~gradio~~ → radio, grade	Misspelled words	Correctness
172.	~~et al~~ → et al.	Comma misuse within clauses	Correctness
173.	~~has~~ → have	Faulty subject-verb agreement	Correctness
174.	the center	Determiner use (a/an/the/this, etc.)	Correctness
175.	*The research only focuses on the Cisarua*	Hard-to-read text	Clarity

	Hot Springs by using a magnetometer with a gradiometer.		
176.	~~And also~~ → Moreover,, Furthermore,	Inappropriate colloquialisms	Delivery
177.	also,	Punctuation in compound/complex sentences	Correctness
178.	the Magnetotelluric	Determiner use (a/an/the/this, etc.)	Correctness
179.	*MT; E.H.*	Text inconsistencies	Correctness
180.	, and	Punctuation in compound/complex sentences	Correctness
181.	~~gradio~~ → radio, grade	Misspelled words	Correctness
182.	~~subsurface hot~~ → hot subsurface	Misplaced words or phrases	Correctness
183.	~~to~~	Wrong or missing prepositions	Correctness
184.	*Variations of Geothermometry and Chemical-isotopic Compositions of Hot Springs Fluids in the Rehai Geothermal Field, Southwestern China. Journal of Volcanology and Geothermal Research, 142, 243– 261.*	Unclear paragraphs	Clarity
185.	*Encyclopedia of Analytical Science Second Edition. Elsevier Ltd., 149-156.*	Unclear paragraphs	Clarity
186.	*Geothermal Systems on the Island of Java, Indonesia. Journal of Volcanology and Geothermal Research, 285, 47-59.*	Unclear paragraphs	Clarity
187.	*Geothermal Systems on the Island of Bali, Indonesia. Journal of Volcanology and Geothermal Research, 304, 349-358.*	Unclear paragraphs	Clarity
188.	*Interpretation of Gravity and Magnetic Anomalies at Lake Rotomahana:*	Unclear paragraphs	Clarity

Geological and Hydrothermal Implications. Journal of Volcanology and Geothermal Research, 314, 84-94.

189.	~~Gradio~~ → Grade, Radio	Misspelled words	Correctness