PEMETAAN KONSENTRASI GAS RADON DI SEKITAR SESAR AKTIF LEMBANG – JAWA BARAT

MAPPING OF RADON GAS CONCENTRATIONS AROUND LEMBANG ACTIVE FAULT – WEST JAVA

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ABSTRAK

Sesar Lembang merupakan sesar aktif yang terletak di bagian utara Cekungan Bandung. Meski termasuk dalam kategori sesar aktif hingga saat ini belum ada aktivitas pelepasan energi berupa gempa dengan kekuatan yang sangat besar. Penelitian ini bertujuan untuk memetakan tingkat aktivitas Sesar Lembang berdasarkan konsentrasi gas radon yang dikeluarkan dari perut bumi. Akuisisi data dilakukan dengan menggunakan detektor radon Rad7 di Lembang, Kota Bandung, dan Cisarua. Pengolahan data menggunakan metode Inverse Distance Weighting yang divalidasi dengan kontinuitas sesar dan hasil penelitian lainnya. Hasil pengukuran emisi gas radon segmen barat lebih tinggi dibandingkan segmen timur sehingga terdapat kesamaan antara aktivitas seismik dengan emisi gas radon. Hasil penelitian menunjukkan bahwa pada bulan Oktober 2020 emisi terbesar dari aktivitas gas radon berada tepat di atas Kota Lembang dan sekitar Cigugur Girang, hal ini perlu mendapat perhatian serius dari Pemerintah Kota Bandung untuk selalu waspada sebagai langkah mitigasi gempa karena berada di atas kepadatan sesar penduduk. dan pemukiman sangat tinggi.

Kata kunci: Gas radon, Sesar Lembang, Mitigasi Gempabumi

ABSTRACT

The Lembang Fault is an active fault located in the northern part of the Bandung Basin. Even though it is included in the category of active fault, until now there has been no energy release activity in the form of an earthquake with a very large strength. This study aims to map the level of activity of the Lembang Fault based on the concentration of radon gas released from the bowels of the earth. Data acquisition was carried out using the Rad7 radon detector in Lembang, Bandung City, and Cisarua. Data processing uses the Inverse Distance Weighting method which is validated by continuity of faults and other research results. The results of the measurement of radon gas emission in the western segment are higher than in the eastern segment so that there is a similarity between seismic activity and radon gas emissions. The results showed that in October 2020 the largest emission from radon gas activity was right above Lembang City and around Cigugur Girang, this needs serious attention from the Bandung City Government to always be vigilant as an earthquake mitigation measure because it is above the population fault density. and settlements are very high.

Keywords: *Radon gas, Lembang fault, Earthquake Mitigation.*

1. Introduction

This The Lembang Fault is an active fault that stretches 29 kilometers from Ngamprah, West Bandung Regency through Cisarua, Parongpong, Lembang to approach the foot of Mount Manglayang Cilengkrang in the east. Fault activity can be seen from the earthquake in the fault [1].

The Lembang Fault activity can be seen in Figure 1, we use earthquake data from the BMKG in October 2020 when radon measurements were taken, the Lembang Fault activity was proven by the presence of earthquake activity along the Lembang Fault. Then the BMKG for the 2010-2012 period recorded earthquakes due to the Lembang Fault activity as many as 14 times with small magnitudes from M1.2 to M3. 3. During that time an earthquake measuring 3.3 on the Richter scale that occurred on August 28, 2011, with a very shallow depth caused damage in the form of cracks in the houses of residents in Muril Village, Jambudipa Village, Cisarua District, West Bandung Regency [2].

During the 2009-2015 period, four earthquake events along the Lembang Fault were identified using the BMKG regional earthquake sensor network (Figure 2). In addition, two earthquake events on 14 and 18 May 2017 were detected in the Lembang Fault. Earthquakes of magnitude 2.8 and 2.9 that occurred on May 14 and 18 2017 impacted the MMI II-III intensity scale but did not cause any damage [3]. By knowing the activity of the Lembang Fault, which until now has released energy on a small scale, it is necessary to be aware of the large accumulated energy release that has not been released, due to the release of energy that has been accumulated on a large scale, potentially occurring in the future. Paleoseismological research has also revealed the potential for periodic energy release of the Lembang Fault every 500 years [4].

Meanwhile, the results of studies of paleoseismological research (studies of past earthquake events) found that the Lembang Fault had released large amounts of energy in the 1600s [5]. Recent paleoseismological studies have shown some evidence of fault activity approximating a seismic return period based on geological timing. This study concludes that in the last 2, the Lembang fault was able to produce earthquakes of magnitude 6.8 and 6.6 on the Richter scale of about 2 and 0.5, respectively. Therefore, this fault has the potential to trigger another earthquake of comparable magnitude in the next period [6].

Based on the formula for the return period of the Lembang Fault of about 500 years, based on the calculation of the 1600s, the probability of an earthquake occurring again is proportional to that which occurred in the Lembang Fault area around 2100. Until the 20th century, BMKG seismograph network records did not see any release of energy in the form of earthquakes can be seen in Figure 2. Big as happened in the 16th century. This is the background of the research. Entering the 500th anniversary of entering the 21st century, research to determine the movement of the largest faults becomes interesting to do. The largest fracture data can be a potential source of earthquakes.

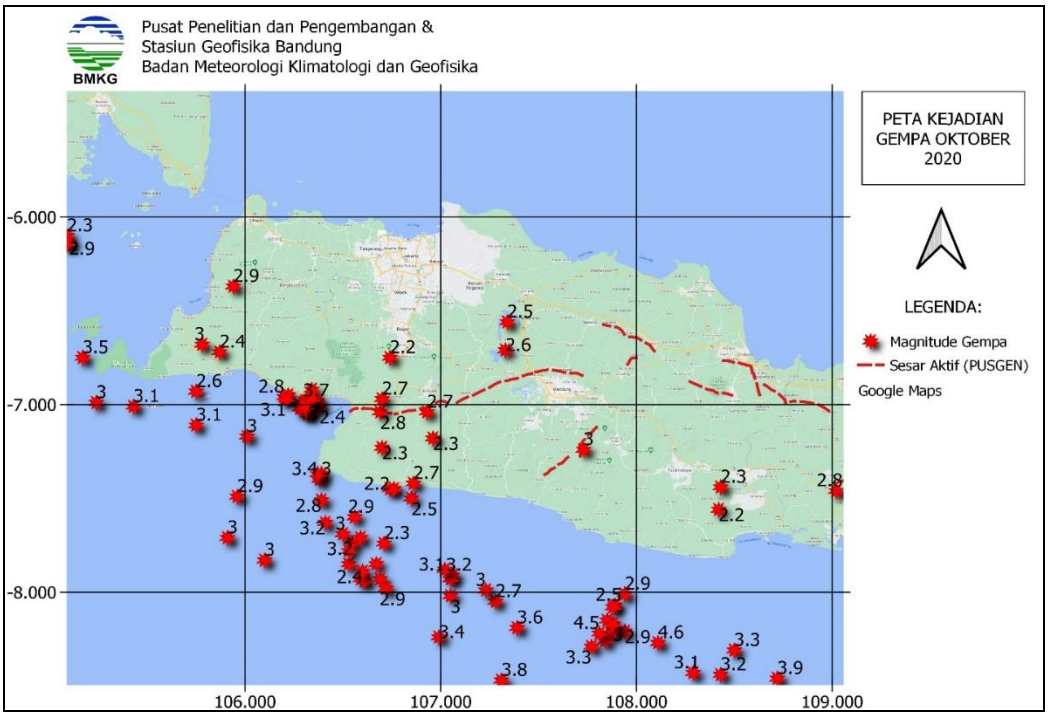

Figure 1. Seismic Activity Around The Research Area.

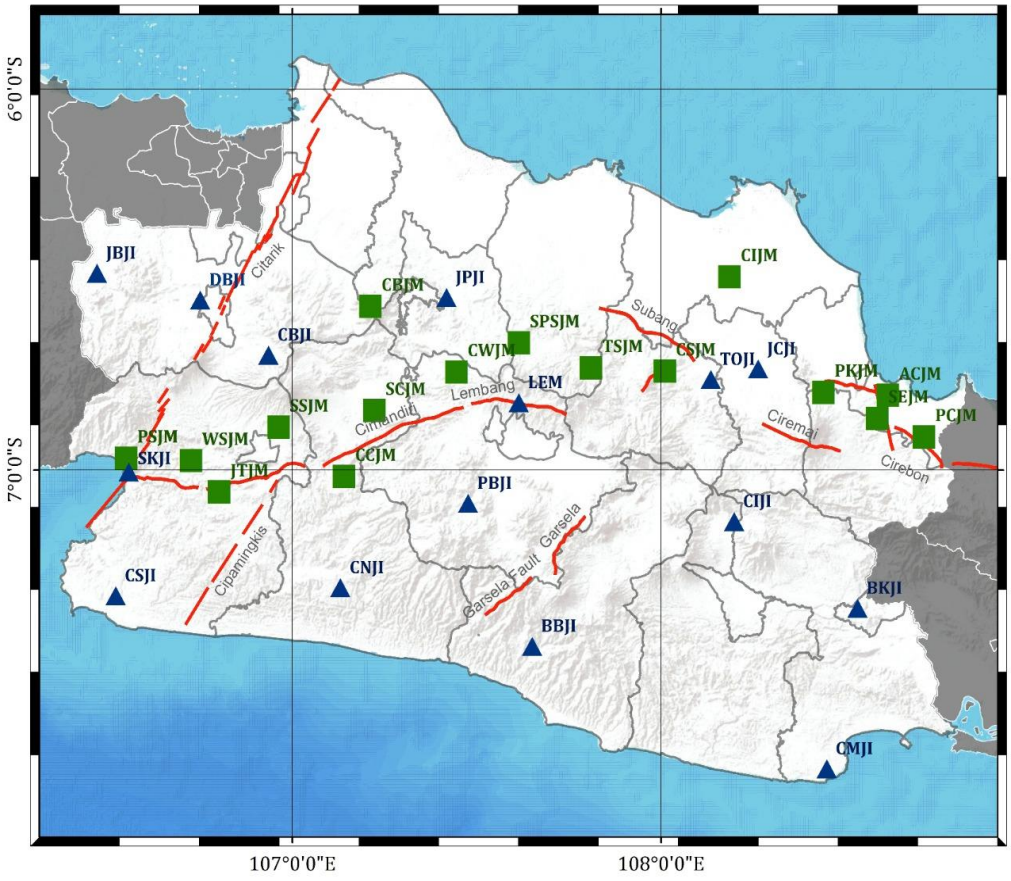

Figure 2. BMKG seismograph network station.

One of the ways to reveal the largest fractures along the fault movement can be done by monitoring the activity of Radon gas. In this area, we investigated the activity of radon gas around the Lembang Fault. This activity of radon gas can provide initial information about potential locations below the surface that experience fractures with the release of high radon gas.

The Lembang Fault activity continues to experience movement, this activity will be locked at one point of the rock separation wall, while other movements continue to show pressure at the locking point. This condition causes a buildup of energy at the end of the locking point so that in time the flexibility of this rock is no longer able to withstand stress activity, so this is where the potential for an earthquake will occur. The greater the energy accumulation that can be held in the rock, the greater the potential for an earthquake to occur. At the point where the key is located, it can be defined as the main source of cracks or fractures between two fault planes. At several points in the boundary plane, we can also monitor through research the location of radon gas emissions. Radon is a chemical element in the form of a gas. This gas can be found beneath the earth's surface and in rocks in various concentrations, whether in soil, air, or water. One of the benefits of measuring radon gas is that it can track the presence of moving air masses and groundwater due to the dynamics of geological faults, and can also be used as a tool to predict earthquakes [7].

The radon gas that fills these gaps can then become a gas that is stored in the pore space or it can migrate to the surface with other gases. As a result, the concentration of radon can increase, which can then be captured by the radon sensor as a higher concentration value. With the characteristics of radon gas, it is very important to make radon gas as a research material, because the results of research that can determine the location of the presence of high concentrations of radon gas can be an indication that it is below the earth's location. From the surface, there are cracks and radon gas that come out of the porous rock [8].

Radon gas research can be a mitigation measure for earthquakes because it can monitor location points that emit radon gas concentrations that come out of faults. Radon gas is released when there is a disturbance in the fault plane and indicates active disturbance. From these results, the first steps can be taken to mitigate which Lembang sub-fault area is active so that monitoring of seismic activity in the sub-fault can be carried out. Earthquakes are natural phenomena that occur suddenly, so it cannot be predicted when the details will occur and how big. Therefore disaster mitigation is very important to reduce disaster risk.

2. Research Methods

Data acquisition was carried out by measuring the concentration of radon gas in closed artesian wells using radon sensor equipment in the areas of Bandung, Lembang, and Cisarua can be seen in Figure 3.

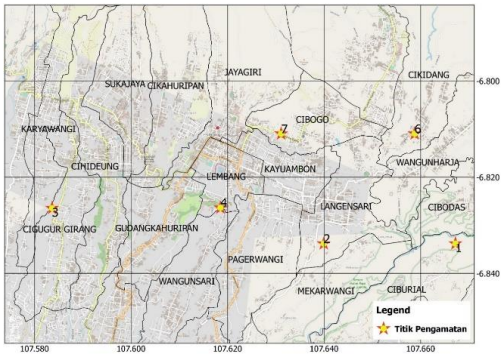

Figure 3. Measurement Points for Radon Gas Observation.

This study aims to analyze the activity of radon gas from around the area. The results of recovery and processing of radon gas concentrations which are further processed by the interpolation method are shown in Table 1.

Table 1. Radon Max concentration (Bq/m3).

No	Lat	Long	Konsentrasi Radon Max (Bq/m3)
1	-6,833	107,667	16.583
2	-6,833	107,639	20.150
3	-6,826	107,583	25.598
4	-6,826	107,618	29.600
5	-6,821	107,674	6.306
6	-6,810	107,658	10.901
7	-6,810	107,631	15.970

3. Results And Discussion

The results of research that has been carried out using the Inverse Distance Weighting (IDW) method from 7 radon gas observation points are shown in Figure 4. These results indicate that the highest concentration of radon gas was observed in Lembang City with the red color concentration. Getting to the left to the west in the villages of Cihideng and Cigugur Girang shows a higher concentration of radon gas than the concentration of radon in the east. This indicates that the Lembang region in the southwest is more vulnerable than the eastern part.

The movement of the Indo-Australian Plate vector to the north affects the movement of the Lateral Sinistral Plate [1]. From the results of data processing of Rad 7 data installed in several areas around the Lembang Fault, the concentration of radon gas is higher than the left to the west in the villages of Cihideng and Cigugur Girang, it is correlated with the movement of the Lembang Fault which has left lateral kinematic.

The results of this study are also reinforced by the geological conditions of the Lembang Fault which is at least 10 km to the west. The results of Australian plate GPS slip measurements show the average azimuth direction of N20-21° east. The general tendency of the Lembang Fault is N282° east, therefore the kinematic possibility of the Fault is left lateral. The general direction of the pressure axis of all the events scattered in the western Lembang Fault provides evidence for this idea. The direction of occurrence of the mean is the oblique left oblique fault with the mean pressure axis N 225.3° E.

Based on the map, the active Lembang Fault is in the middle of the study area, in the southern part there is a fault which is the boundary of the active Lembang fault associated with the Old Volcanic Product Formation which cannot be separated. The value of radon gas concentration in this region is at the highest value compared to other areas, namely in the range of 20,150 - 29,600 Bq/L. This value gets bigger as it approaches the active Lembang fault can be seen in Figure 5.

The value of radon gas in the northern part of the Lembang Fault has a relatively lower value compared to the southern part because of the sub-fault in the southern part of the study area, besides that, the northern Lembang fault is dominated by Tuff and Lava, which cover the fracture can be determined based on the mapping of morphological features.

At the western end, the Fault line turns slightly south to form a horse's tail. At the southern end of this horsetail shape, another fault line that

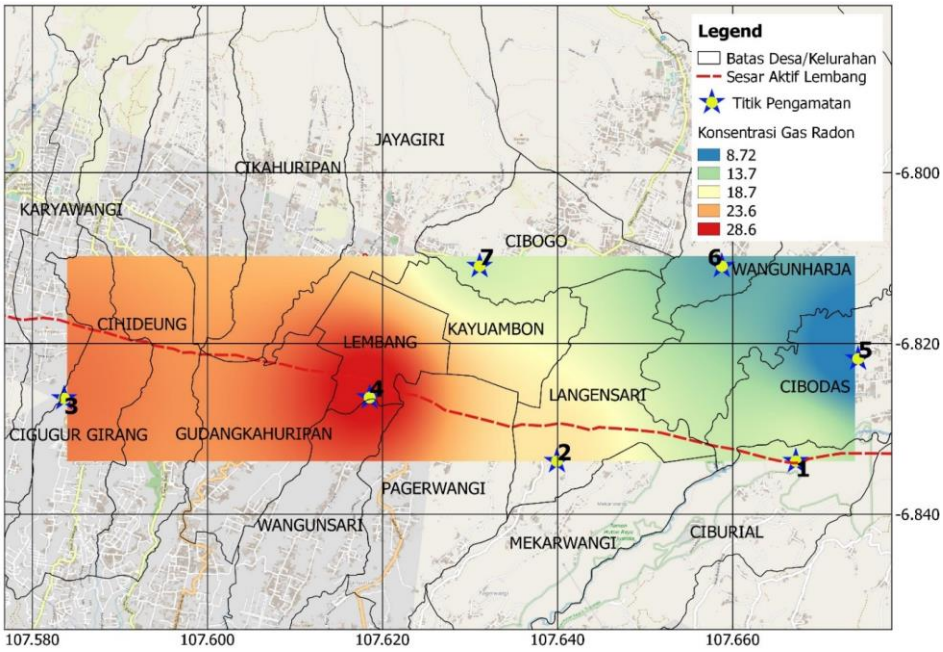

Figure 4. The contour of radon gas concentration values around the active Lembang-Jabar fault.

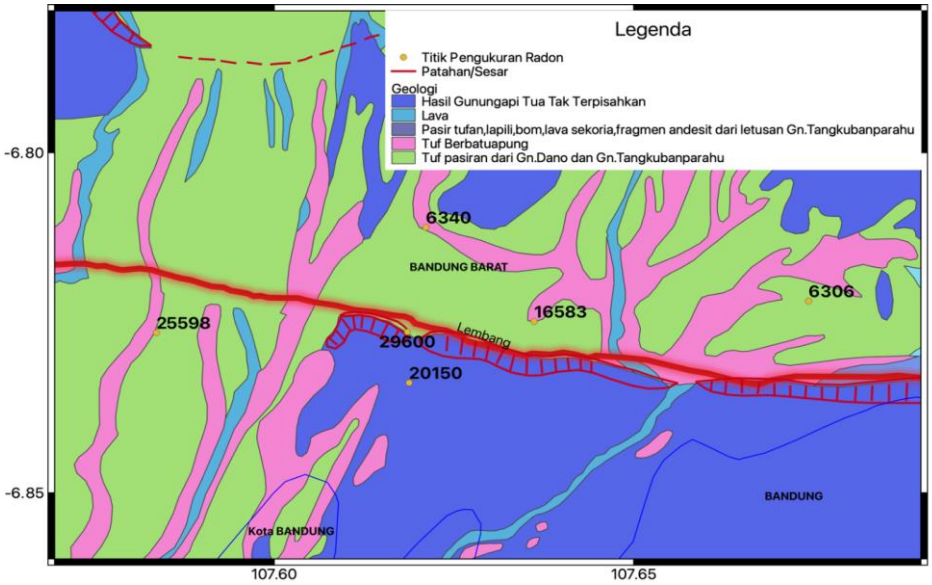

Figure 5. The geological map of the study area is overlaid on the Radon gas concentration value.

extends almost parallel to the Lembang fault to the north of this line, the geometry of the Lembang fault averages about 277° which is not much different from the surface trend line 282°, a slope of about 85° and a slope of about 35°. The distinctive form of a ponytail is the presence of a fault line and additional lines called transitional jogging. This event occurred in the eastern part of the Lembang fault which is spread over the area where the graben structure developed at the time of the massive eruption of the Sunda Volcano around 0.2-0.18 Ma. These results can be used as validation material for the locking point of the two fault

boundaries as a source of fracture that provides the greatest earthquake energy. For the intermediate concentration values found in the western region, it is necessary to predict that the sub-fault area will experience an increase in the concentration of radon gas.

4. Conclusion

The Lembang Fault activity is linear with the concentration of radon gas, based on the measurement results of the radon gas concentration there is a match between the activity of the Lembang Fault and the concentration of radon gas. The West Lembang Fault is the most active fault among the three Lembang Fault segments, this is evidenced by the frequency of earthquakes that occur in the western part compared to the eastern part. The measurement results of radon gas emissions in the western segment are higher than in the eastern segment so there is an agreement between seismic activity and radon gas emissions.

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All Authors contributed equally to this work. All Authors discuss the results and implications and comment on this manuscript at all stages.

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