INTERPRETATION OF GAMMA RAY VALUE BASED ON OUTCROP DATA IN SIMPENAN AREA, REGENCY OF SUKABUMI

Yusi Firmansyah[1*], Reza Moh. Ganjar Gani[1], Aji Nurdrajat[1]
[1]Program Studi Teknik Geologi , Universitas Padjadjaran
*correspondence : yusi.firmansyah@unpad.ac.id

ABSTRACT

Natural radiation is the radiation that exists in nature in the form of cosmic radiation and the radiation is derived from the radioactive material present in the earth's crust (IAEA, 2003). This radionuclide is present in almost any material such as earth's crust, rocks, soil layers, seawater, building materials and human bodies of different levels. Generally these radiometric traces of an outcrop depend on the original rock that can be seen from petrology. The geological condition of Ciletuh in Sukabumi Regency is quite complex, seen from the structure of rocks, the characteristics of rocks, stratigraphy and also the landscape, thus making the area of Ciletuh interesting enough to serve as the location of research research in the field of Geology. Landslide disaster is one of the most common disasters in Indonesia. Based on data from the National Disaster Management Agency (BNPB) within the period of 2011-2014 there were 493 cases of landslides recorded in Indonesia. The potential of disaster and landslide vulnerability is a threat to the people of the Simpenan area, Sukabumi Regency which has geographical condition that is prone to landslide disaster. The purpose of this research is to know the distribution of Gamma Ray value in exposed rock and to see the relation of Gamma Ray value distribution with landslide prone area in research area. In the field observation, the lithology was 70% dominated by polymic breccia as well as 30% sandstone and claystone. The mean overall gamma ray value in the study area was 0.036 μSv / h. The landslide-prone areas in the study area have high gamma ray values and are located in areas with steep to steep slopes (8-35 °) where the reliefs are controlled by claystone lithology which has high potassium and thorium contents and is susceptible to weathering, erosion and prone to landslides.

Keywords: Gamma Ray, landslide, Stratigraphy

I. Introduction

The geological condition of Ciletuh in Sukabumi Regency is quite complex, seen from the structure of rocks, the characteristics of rocks, stratigraphy and also the landscape, thus making the area of Ciletuh interesting enough to serve as the location of research research in the field of Geology. Landslide of mass motion of land undergoing mass movement of soil / rock in upright, horizontal or sloping direction from the original position. Landslides often hit the hilly areas of the wet tropics. (Zacharias, 2011). The landslide caused by movement of soil at high humidity level, steep slope, less compact material and rare plants based on Verhoef (1985; in Zakaria, 2011). Seepage and geological activities such as fractures and fractures are other factors of landslide and local drainage conditions are closely related to the slope stability condition is closely related to the drainage condition, shape and slope of the slope.

Radioactivity (radioactivity) is an activity of an element in the radiation / emitting of radioactive rays spontaneously. Radiation that comes from nature and not from the results of human activity is called natural radiation. Natural radiation is the radiation that exists in nature in the form of cosmic radiation and radiation derived from radioactive material present in the Earth's crust (IAEA, 2003). Radiation seen from the mass is divided into 2, namely particle radiation (radiation having mass) and electromagnetic radiation (radiation having no mass). One example of this electromagnetic radiation is gamma radiation. Gamma radiation is the electromagnetic radiation emitted from the nucleus of an excited atom that follows the process of radioactive decay, as a way of discharging excitation energy to dispose of excitation energy to its basic level (Sugiharyanto et al., 2009). Gamma radiation can interact with the material it passes, in which radiation interacts generally transfers its energy to the material or matter involved and will cause contamination of the interacting material. These radionuclides are generally derived from soil or rocks and mineral materials containing Thorium series (232Th), Uranium series (238U) and Potassium (40K). The rate of gamma ray dose in each region varies depending on the radionuclide element in each rock in the area.

II. Research Methods

The method used in this research is field orientation method and supported by the use of GPS (Global Position System). Field orientation method is done by determining the observation station point to the points that can be recognized on the map and supported by using GPS so that the use of time is more efficient and plotting more accurate. The gamma ray data retrieval method is measured by placing a gamma ray instrument (Horizontal Radi PA-1100 type) on the surface of the rock. Location determination (plotting) based on GPS usage. By placing the instrument, we get the result of gamma ray value at the measurement location with unit value μSv / h. The stage of studio work is the analysis phase of the measurement results obtained in the field and then in the plot into the framework map and deployed using the help of software with geostatistics method.

III. Research Result

3.1.Slope

In the area of morphological research that developed is a high hills with surface elevation at 760-1.109 m above sea level. Different forms of landscapes are caused by exogenous and endogenous processes in the study area. The northwest-trending morphological changes, based on the classification of the slopes of Van Zuidam included into the sloping plateau controlled by soft lithology / less resistant to weathering and temporary erosion in the North, East and South are steep reliefs controlled by weather-resistant and erosion-resistant lithology. (Figure 1). The slope of the slope in the study area is generally a gentle slopes that fill about 25% of the total research area. While the other slope grade class, which is steep up to steep filling approximately 75% of the total research area, Slope slope in the research area is dominated by slope of the slope ranges from 8-35 °. According to Van Zuidam (1985) this land has a steep slope to steep, frequent erosion and movement of the ground at a slow pace. This area is prone to erosion and landslides.

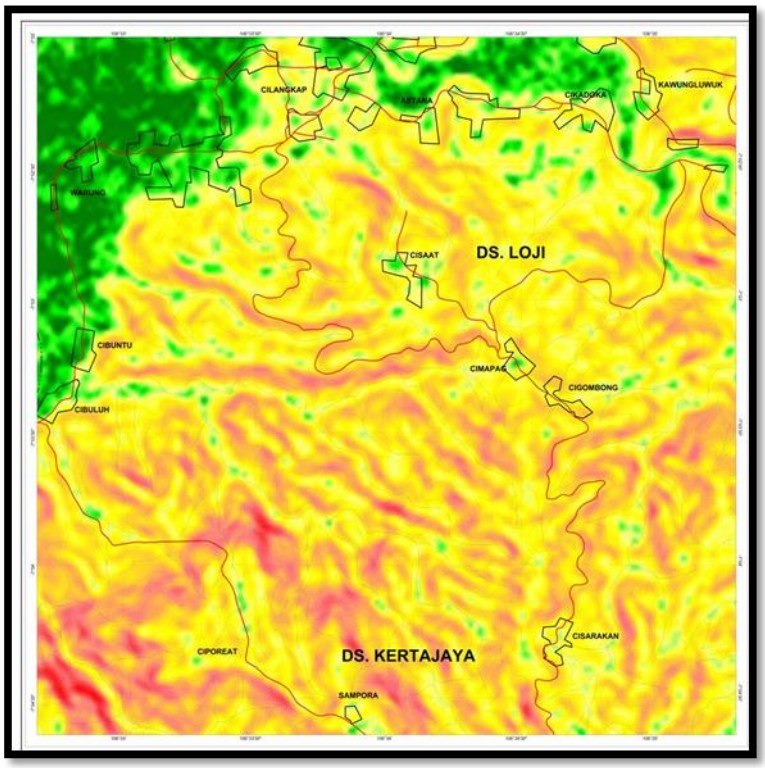


Figure 01. Slope Map of the research area

3.2.Lithology

The dominant rocks in the study area consist of polymic and sandstone breccias. The distribution of polymic breccia in the research area is about 70% of the research area. The rock is exposed in the southern part of the research area and along the main road of Pelabuhan Ratu. Circumstances vary, some are not good anymore or fresh. This can be seen because the area of research is part of the origin of the old mountainous areas that resulted in the presence of several components in this breccia stone. Based on the

characteristics of lithology in the field and supported by thin incision data, the Breccia Polymic rock has a sandstone matrix and looks slicken sided (figure 2). Megaskopis Breksi Polimik has physical characteristics, namely; fresh brown color, darkish brown weather. It has several suspected components of a conglomerate, sandstone, and andesite, sandstone matrix, rugged, dense, and finely enclosed, with a massive sedimentary structure, alluvial fan deposits, as seen microscopically as a volcanic rick-which forms in the alluvial fan deposition environment. Microscopically the components of the Breccia Polymic Unit are divided into 3 (three), namely; (a) Conglomerate, one of the components of the polymic breccia seen through a thin incision (+ X nikol) (figure 3), (b) Sandstone, seen through a thin incision (+ X nikol) (Figure 4), (c) Andesite Lytic Tuff. seen through a thin incision (+ X nikol) (Figure 5).

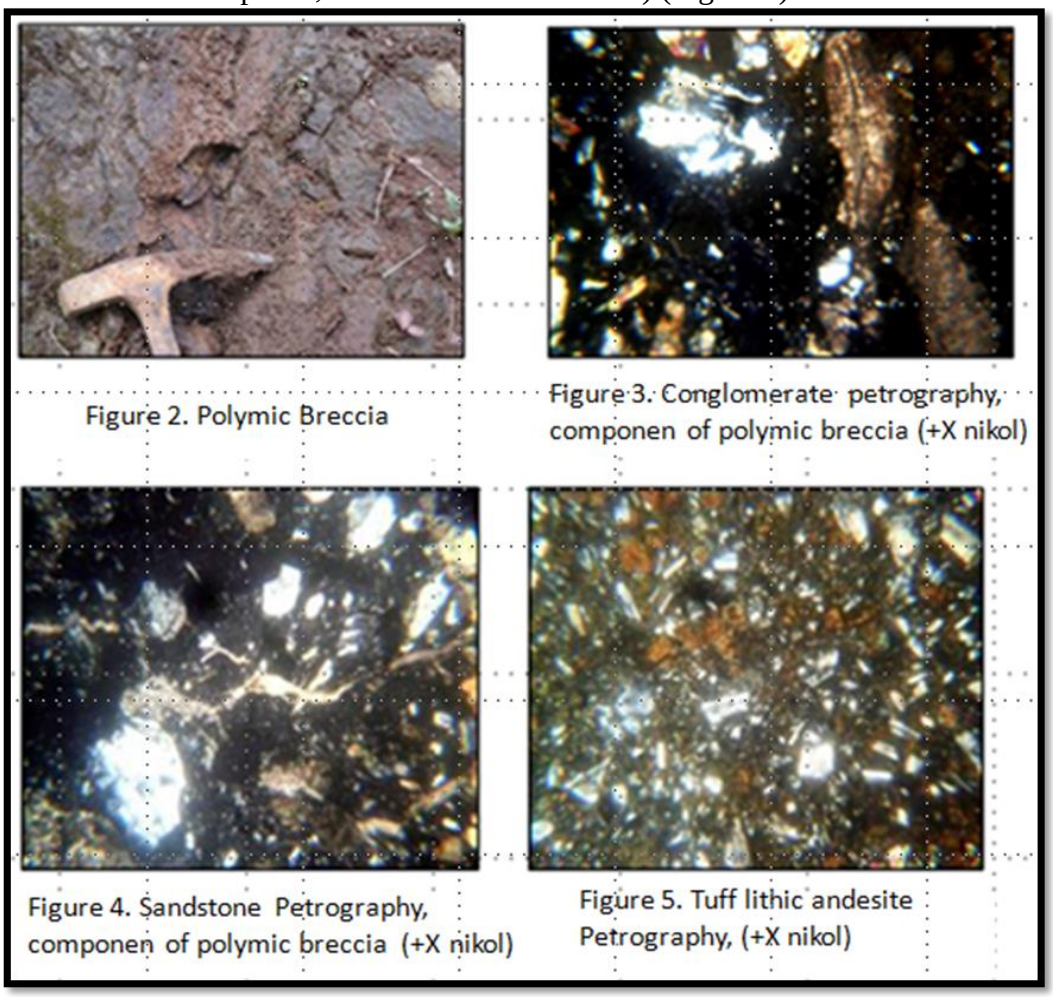


Figure 2. Polymic Breccia

Figure 3. Conglomerate petrography, componen of polymic breccia (+X nikol)

Figure 4. Sandstone Petrography, componen of polymic breccia (+X nikol)

Figure 5. Tuff lithic andesite Petrography, (+X nikol)

Rocks that have a coverage area of 30% of the area of research and revealed along the Cijarian River is sandstone. Based on the characteristics of lithology in the field as well as supported by petrography analysis of Carbonatan Sandstone (figure 6) is in Northeast study area and there is also Batulempung. Megaskopis this claystone has physical characteristics; fresh gray color and blackish ash color as well as having carbonate content and there is a

component of shell fragments while sandstone sandstone has a physical characteristic, brown with lapel black brown, medium grain sand size - very fine sand, circular round, open - closed, good sorting and poor permeability. This rock has a massive sedimentary structure and there is a fractional component of fossils (Figure 7). Microscopically using a microscope (+ X Nikol) this carbonate sandstone has a grayish brownish color, massive structure, bad disaggregation and packing is still covered. The badly sorted carbonate sandstones with granular components present quite a lot, consisting of; Quartz, feldspar, and plagioclase are still relatively fresh, Carbonatan sandstone units are located in the environment of deposition of the Open Sea visible on the fossil is still a shell. The andesite and dacite volcanic rock fragments are mostly fresh even though some have been altered and oxidized; pieces of sedimentary rocks of sandstone and sandstone appear to have been partially altered.

Figure 6. Sandstone Outcrop

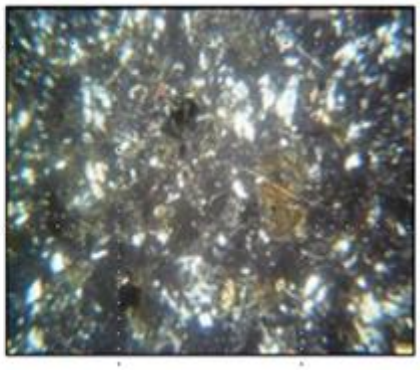


Figure 7. Sandstone Petrography

3.3. Distribution of Gamma Ray Value

Measurement of gamma ray value by placing gamma ray instrument (Horiba Radi PA-1100 type) on the surface of the rock. In the study area, gamma ray values were identified in rocks by placing detector instruments on the rock surface. (Figure 8). The rocks in the research area are polymic breccia, claystone and sandstone. The distribution of gamma ray values can be seen on the skeleton map (figure 09). The mean overall gamma ray value in the study area was 0.036 μSv / h. based on the distribution of gamma ray values in the study area, gamma ray values in breccia were in the range of 0.036-0.050 μSv / h with an average value of 0.045 μSv / h, and the value of gamma rays in the sandstone was in the range 0.025 - 0.036 μSv / h with average value of 0.034 μSv / h. Based on the distribution of gamma ray maps (figure 10) the general results obtained, that the value of gamma rays getting higher to the North - Northeast. While the gamma ray is getting smaller to the Southwest and Southeast.

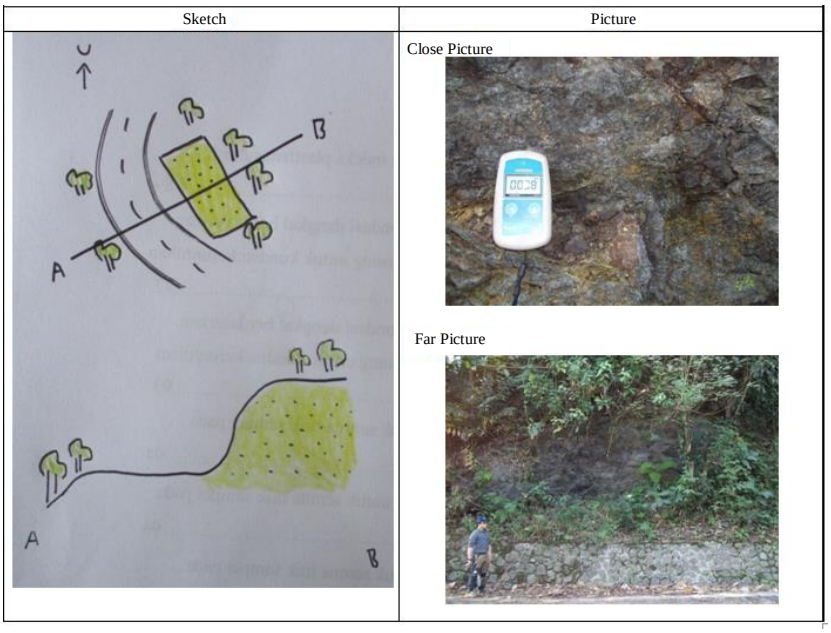


Figure 08. Identification of gamma ray data on sandstone outcrop

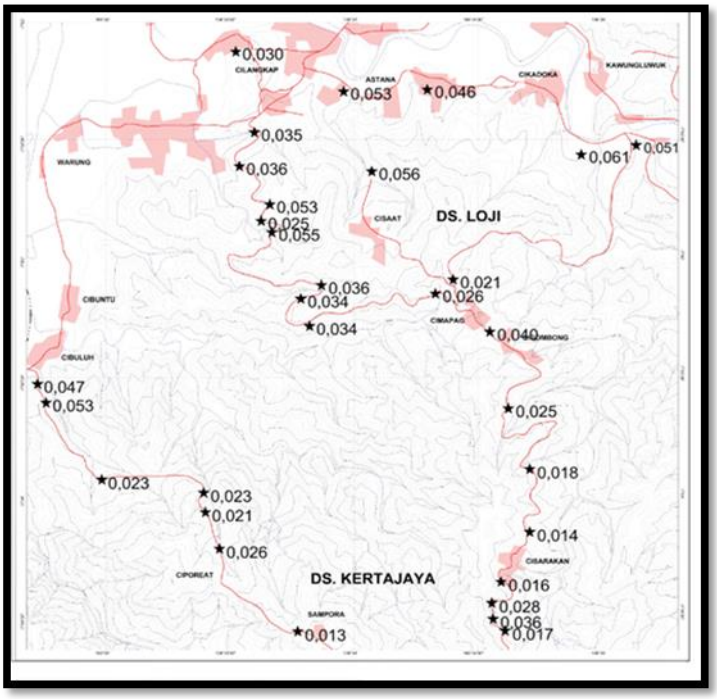
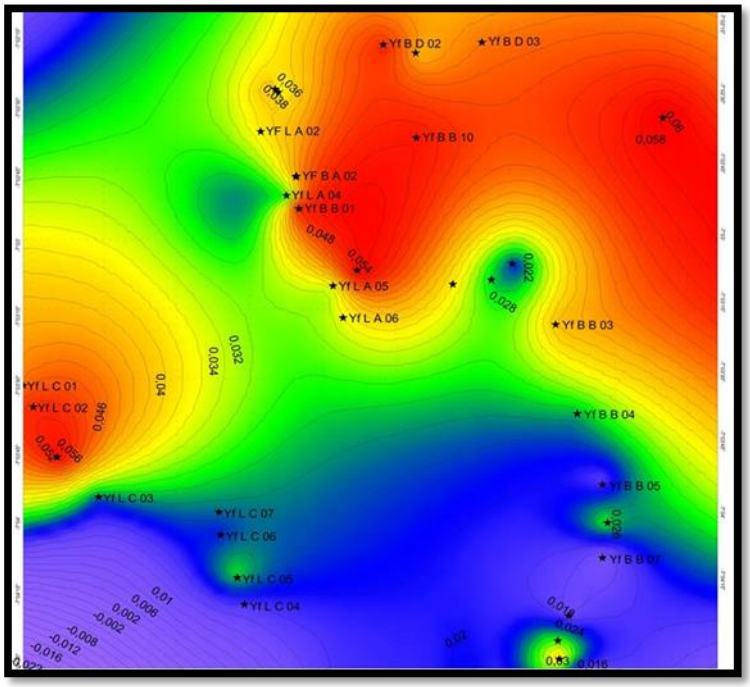


Figure 09. Template map of gamma ray distribution in the study area



Gambar 10. Distribution of gamma ray data.

3.4 Interpretation of gamma ray data distribution

Based on observations in the field of lithology in this research area 70% is dominated by polymic breccia as well as 30% carbonate sandstones and claystone. The steep-to-steep slope class fills approximately 75% of the total research area. From the slope data, the northeastern of the research area is in landslide prone areas and has a high gamma ray value of 0.052 - 0.069 (μSv / h). If the result of this gamma ray value is compared with slope data and lithology of landslide prone area, it is found that in the northeast direction has a high slope value, the gamma ray is also relatively high and its lithology is claystone. In the area of claystone according to Supper et al (2013) has high Potassium and Thorium content. The landslide-prone areas are in areas with steep to steep slopes (8-35 °) where the reliefs are controlled by claystone lithology susceptible to weathering and erosion.

IV. Conclusion

1. Lithology in the area of research dominated about 70% by polymic breccia rocks. These rocks are microscopically composed of 3 components namely conglomerate, sandstone and tuff litik andesite. While the distribution of 30% in the area of research is filled with sandstone lithology and claystone.
2. The value of gamma ray in rocks in the study area was averaged 0.036 μSv / h with an average value of 0.045 μSv / h polymic breccia and a mean value of gamma ray in 0.034 μSv / h sandstones. Different gamma ray values in each rock outcrop may be due to the differences in the amount of radioactive elements contained in the mineral rocks.
3. Based on observations in the field, there are areas prone to landslides. The landslide-prone areas are in

areas with high gamma ray values. The landslide-prone areas are in areas with steep to steep slopes (8-35 °) where the reliefs are controlled by litology susceptible to weathering and erosion, prone to landslides and have relatively high concentrations of potassium and thorium which are relatively rich in clays.

V. ACKNOWLEDGMENTS

With the completion of this scientific meaning, the author would like to thank DRPMi Padjadjaran University who oversees the author for the Unpad Internal Grant which was given with the Fundamental Research Program of Unpad (RFU) so that this research was carried out well

Reference

Hardiyatmo, H.C. 2002. *Mekanika Tanah I*. Universitas Gadjah Mada. Yogyakarta

Hermann, L., Schuler U., Rangubpit, W., Erbe P., Surinkum A., Zarei, M., Stahr, A. 2010. *The Potential of Gamma Ray spectrometry for soil mapping*. 19th World Congress of Soil Science, Soil Solutions for a Changing World, p 117. Austria

Hesselbo, Stephen P. 1996. *Spectral gamma ray logs in relation to clay mineralogy and sequence stratigraphy, cenozoic of the atlantic margin, offshore new Jersey.* Proceeding of the Ocean Drilling Programs, Scientific Results,Vol.154. New Jersey

IAEA. 2003. *Guidelines for radioelement mapping using gamma ray spectrometry data.* IAEA-TECDOC-1363. Austria.

Suhariyono, G, Buchori, Iskandar D,. 2007. *Laju Dosis Radiasi Gamma di Lingkungan Pulau Jawa.* Pusat Akselerator dan Proses Bahan – BATAN. Yogyakarta.

Sugiharyanto, Nursa'ban M, Khotima N,. 2009. *Study of Landslide Susceptibility in Samigaluh to Effort the Mitigation of Hazard.* Hasil Penelitian Strategis Nasional Batch 1 tahun 2009. Yogyakarta

Supper,E, Baron, R, Winkler, K. Motschka, A, Carman, M, Kumelj,S., et al. 2013. *Airborne geophysical mapping as an innovative methodology for landslide inverstigation : evaluation.* Natural Hazard and Earth System Sciences. Austria.

Van Bemmelen, R.W. 1949. The Geology of Indonesia, volume I.A. The Hague Martinus Nijhoff, Netherland.

Zakaria, Z. 2009. *Analisis Kestabilan Lereng Tanah*. Tersedia pada http://blogs.unpad.ac.id/zufialdizakaria/ (diakses pada November 2016)

Zakaria, Z. 2011. *Analisis Kestabilan Lereng Tanah*. Tersedia pada http://blogs.unpad.ac.id/zufialdizakaria/ (diakses pada November 2016).