Assessment of Regional Development Using the Unit Genetic Area (GSW) Method in the Mining Environment Area of Palu City, Central Sulawesi Province

Moh. Nur Rehan Pratama[a,1,*] , Muslimin U. Botjing[a,2] , Nurhikmah Supardi [a,3]

[a] Department of Geological Engineering, Faculty of Engineering, Tadulako University, Jl. Soekarno-Hatta KM 9, Palu City
[1] nurrehan32@gmail.com*
* corresponding author

ARTICLE INFO

Keywords
Excavation_mining
Regional Genetic Unit
Mining Area Development

ABSTRACT

Introduction: The growth of the mining industry in Central Sulawesi is currently growing rapidly, starting from excavations A, and B to C. The Buluri area currently has many active C excavation mines, but does the area have the potential for mining area development? This research was conducted with the aim of knowing the level of potential or constraints on the development of mining areas. **Method**: The location of this research is located in Buluri Village, Ulujadi District, Palu City, Central Sulawesi. The method used in this research is direct mapping in the field to determine the genetic unit of the region and scoring on each subfactor of the genetic unit of the region to determine the development of mining areas. **Results and Discussion**: The results showed that in the Buluri area, there are two regional genetic units, namely the genetic unit of the moderately deformed porphyry andesite plain area (1221) and the genetic unit of the moderately deformed porphyry andesite hills area (1222). **Conclusion**: Based on the results of subfactor calculations in each regional genetic unit, it is found that the genetic unit of the moderately deformed porphyry andesite plain area (1221) is included in the low-level mining area development category, and the genetic unit of the moderately deformed porphyry andesite hills area (1222) is included in the medium- level mining area development category.

1. Introduction

The growth of the mining industry in Central Sulawesi is currently growing very rapidly, recorded until now there are a total of 321 active companies [1]. Starting from excavation A such as oil and nickel mines, excavation B such as gold and copper mines to excavation C such as andesite mines and sirtu (sand and rock) mines which are spread almost evenly in every district and city in Central Sulawesi. An area where there are many mining areas, of course, has geological characteristics in the development process [2]. To be able to know this, of course, regional mapping must be done first. One of the complex regional mapping methods for determining geological characteristics based on regional development is the regional genetic unit method [3]. Regional genetic unit is a regional mapping method that combines genetic elements (lithology, morphology, and deformation) of an area in the form of *scoring* so that this method can present geological characteristics along with potential factors and constraints of an area to be developed [4,5,6].

Administratively, the research location is located in Buluri Village, Ulujadi Sub-district, Palu City, Central Sulawesi Province. The research location is 14 km from Palu City which can be

reached using land transportation such as motorbikes and cars with ± 26 minutes or can also be reached on foot with a travel time of ± 3 hours.

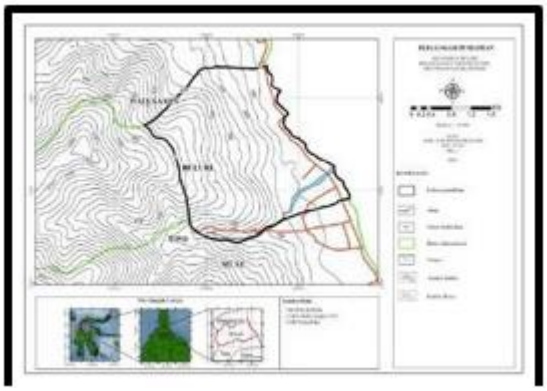

Fig. 1. Research Location Map

Regional geomorphology physiographically the Palu area consists of the east ridge and the west ridge, both of which run north-south and are separated by the Palu valley (Fossa Sarassin). The west ridge near Palu is up to more than 200 meters high, but in Donggala it drops to sea level. The eastern ridge peaks from 400 meters to 1900 meters high and connects the mountains of Central Sulawesi with the northern arm.

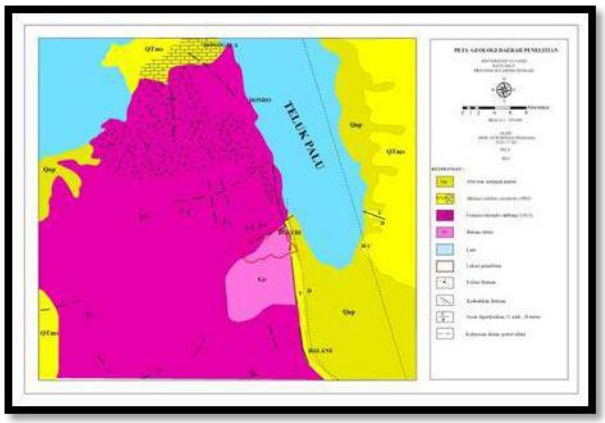

Fig 2. Regional Geologic Map of the

The Buluri area is included in the intrusive rock formation (Gr). Intrusive rocks (Gr) have been observed for several generations of intrusions, of which the oldest are small andesite and basalt intrusions on the Donggala peninsula. These intrusions may be channels of volcanic rocks within the Tinombo formation. Small intrusions (50m wide) generally composed of diorite, porphyry diorite, and granodiorite cut through the Tinombo formation, which is before the molasa deposits and is widespread throughout the area. All unmapped, mapped granites and granodiorites are characterized by up to 8 cm long potassium feldspar phenocrysts. Regionally, the geologic structure of the island of Sulawesi began in the Triassic period, especially in the Banggai-Sula mandala which is the oldest mandala, while in the eastern Sulawesi Mandala, the geology began in the late limestone or early tertiary. Strong folding caused the occurrence of stepping faults that took place in the middle Miocene in the eastern arm of western Sulawesi, and at the same time local transgression took place in the southeastern arm of Sulawesi and volcanic activity occurred in the northern and southern arms [1]

2. Method

The research methods used in this study were quantitative and qualitative [7]. Quantitative and qualitative methods are carried out using regional genetic unit analysis using field data such as rock lithology data, conditions of deformation levels, and field morphology in the form of slope, and height differences so that the type of morphology of the research location can be determined [8]. Mining area development is carried out after determining the name of the genetic unit of the research area, where each genetic unit of the area will contain seven determining factors in terms of the potential for mining area development from each genetic unit of the area obtained. Valuation or *scoring* is done realistically for each SGW factor and subfactor. The weight of importance is a measure of the contribution of the factor to the importance of the mining area development plan

3. Results and Discussion

In the research area, two regional genetic units were obtained, namely the genetic unit of the moderately deformed porphyry andesite plain area (1221) and the genetic unit of the moderately deformed porphyry andesite hills area (1222). The genetic unit of the moderately deformed porphyry andesite plain area is characterized by morphographic appearances that are at a relative height of 0- 50 meters. With a moderate level of deformation with the presence of many bridles in rock outcrops, this unit is composed of andesite porphyry rock lithology. The genetic unit of the moderately deformed andesite porphyry hilly area is characterized by morphographic appearances that are at a relative height of 50-650 meters. With a moderate level of deformation characterized by the presence of many bridles in rock outcrops, this unit is composed of andesite porphyry rock lithology.

Scenarios for the development of mining areas in the moderately deformed porphyry andesite plateau SGW (1221) have been carried out through holistic matrix management based on data obtained in the field. The weights on the onsite and *offsite values* for the current condition and if developed are all multiplied by the weight value of each subfactor, resulting in a total value of onsite and *offsite* in the current condition and if developed. The total value in the current condition is 112 which consists of onsite 28.7 and *offsite* 83.3 and the total value in the condition if developed is 47 which consists of onsite (-1.4) and *offsite* 48.4. Based on the regional development scenario formula (current conditions - if developed) the following results are obtained:

$Z = X+Y$

$Z = 112 - 47$

$Z = 65$

Based on data processing from the regional development scenario formula, it is found that the value of the regional development scenario in the genetic unit of the porphyry andesite plain area is 65. In the category of regional development scenario values 65 is included in the low potential category, so it can be seen that the area in the genetic unit of the moderately deformed porphyry andesite plateau area is included in the development of a low potential mining area. The following is a matrix of regional development scenario processing in this SGW.

Table 1. Holistic Matrix Of SGW Of Moderately Deformed Porphyry Andesite Hills

No.	Factor	Subfactor	Current Condition On	Current Condition Off	Total (A)	If Developed Onsite	If Developed Offsite	Total (B)	Difference (A-B)
1	Economic Feasibility of Materials	Accessibility	10	-10	0	10	-10	0	0
1	Economic Feasibility of Materials	Topsoil Storage Area	10	10	20	10	10	20	0
2	Regional Economic Feasibility	Slope Gradient	20	20	40	20	20	40	0
3	Disaster Vulnerability Stability	Elevation from Highway	20	10	30	10	10	20	10
3	Disaster Vulnerability Stability	Natural Slopes	5	-5	0	5	-5	0	0
3	Disaster Vulnerability Stability	Ground Surface	5	5	10	5	5	10	0
4	Natural Disasters	Flood	6.6	6.6	13.2	6.6	6.6	13.2	0
4	Natural Disasters	Landslide	3.3	3.3	6.6	3.3	3.3	6.6	0
4	Natural Disasters	Earthquake	-6.6	-6.6	-13.2	-6.6	-6.6	-13.2	0
4	Natural Disasters	Water	10	10	20	10	10	20	0
4	Natural Disasters	Air	10	10	20	10	10	20	0
5	Pollution	Water	10	10	20	10	10	20	0
5	Pollution	Air	10	10	20	10	10	20	0
6	Reclamation	Vegetation Cover	-10	-10	-20	-10	-10	-20	0
6	Reclamation	Aesthetics	-5	-5	-10	-5	-5	-10	0
7	Social, Cultural, Economic, Legal	Community Perception	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
7	Social, Cultural, Economic, Legal	Community Empowerment	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
7	Social, Cultural, Economic, Legal	Human Resource Development	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
			28.7	83.3	112	-1.4	48.4	47	65
	Total								

The development of mining areas in the moderately deformed porphyry andesite hills SGW (1222) has been carried out through holistic matrix processing, which is based on data obtained in the field. The total value of onsite and *offsite* in the present condition and if developed which has been multiplied by the weighted subfactor value is 53.8 and (-16.2). Which consists of *onsite* current conditions (-12.9) and *offsite* current conditions 66.7 and *onsite* if developed (-38) and *offsite* if developed 21.8. Based on the regional development scenario formula (existing conditions - if developed) the following results are obtained:

$Z = X - Y$

$Z = 53.8 - (-16.2)$

$Z = 53.8 + 16.2$

$Z = 70$

Based on data processing from the regional development scenario formula, it is found that the value of the regional development scenario in the genetic unit of the andesite porphyry plain area is 70. In the category of development scenario value 70 is included in the medium potential category, so it can be seen that the area in the genetic unit of the moderately deformed andesite porphyry hills area is included in the medium potential mining development area

Table 1. Holistic Matrix Of SGW Of Moderately Deformed Porphyry Andesite Hills

No.	Factor	Subfactor	Current Condition On	Current Condition Off	Total (A)	If Developed Onsite	If Developed Offsite	Total (B)	Differen
1	Economic Feasibility of Materials	Accessibility	10	-10	0	10	-10	0	0
1	Economic Feasibility of Materials	Topsoil Storage Area	10	10	20	10	10	20	0
2	Regional Economic Feasibility	Slope Gradient	20	20	40	20	20	40	0
2	Regional Economic Feasibility	Elevation from Highway	10	10	20	10	10	20	0
3	Disaster Vulnerability Stability	Natural Slopes	5	-5	0	5	-5	0	0
3	Disaster Vulnerability Stability	Ground Surface	5	5	10	5	5	10	0
4	Natural Disasters	Flood	6.6	6.6	13.2	6.6	6.6	13.2	0
4	Natural Disasters	Landslide	3.3	3.3	6.6	3.3	3.3	6.6	0
4	Natural Disasters	Earthquake	-6.6	-6.6	-13.2	-6.6	-6.6	-13.2	0
5	Pollution	Water	10	10	20	10	10	20	0
5	Pollution	Air	10	10	20	10	10	20	0
6	Reclamation	Vegetation Cover	-10	-10	-20	-10	-10	-20	0
7	Social, Cultural, Economic, Legal	Community Perception	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
7	Social, Cultural, Economic, Legal	Community Empowerment	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
7	Social, Cultural, Economic, Legal	Human Resource Development	-13.2	-13.2	-26.4	-6.6	-6.6	-13.2	-13.2
7	Social, Cultural, Economic, Legal	Aesthetics	-5	-5	-10	-5	-5	-10	0
			13.2	66.7	133.3	-1.4	48.3	46.9	86.4
	Total								

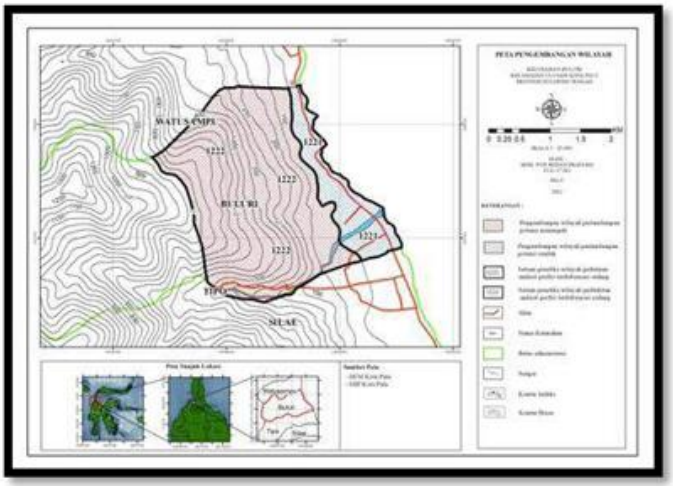

Fig. 3. Map Of Regional Genetic Units And Regional Development At The Research Site

4. Conclusion

Based on the results of data processing and discussion, it can be concluded that in the Buluri area, there are two regional genetic units, namely the genetic unit of the moderately deformed

porphyry andesite plain area (1221) and the genetic unit of the moderately deformed porphyry andesite hills area (1222). The genetic unit of the medium-deformed porphyry andesite plain area is included in the category of low potential mining area development with a value of 65, while the genetic unit of the medium-deformed porphyry andesite hills area is included in the category of medium potential mining area development with a value of 70.

References

[1] Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2022). Ministry of Energy and Mineral Resources Involves Stakeholders to Increase Per Capita Electricity Consumption (NUMBER: 486. Pers/04/SJI/2022).

[2] B. Rahmad, S. Raharjo, E. W. Pramudihadi, and E. Ediyanto, "Introduction to Coal Geology Exploration and Coal Quality," Institute for Research and Community Service (LPPM), Universitas Pembangunan Nasional "Veteran" Yogyakarta, 2017.

[3] Hirnawan, F. 2007. Regional Genetic Map Accompanied by Valuation of Characteristics, Potential and Constraints for Spatial Planning and Best Regional Development. Bandung: UNPAD Graduate Program.

[4] R. W. H. Butler, "Tectonics and Palaeogeography," J. Geol. Soc., vol. 162, no. 1, pp. 115-130, Jan. 2005. [5]I. P. MacGregor, "Geological Structure and Processes: A Practical Guide," in *Proc. Int. Conf. Geol. Struct.*, Boston, MA, USA, 2010, pp. 25-30.

[5] R. S. Anderson and S. P. Anderson, *Geomorphology: The Mechanics and Chemistry of Landscapes*, Dept. of Geology, Univ. of California, Berkeley, CA, USA, Tech. Rep. 123, 2011.

[6] Suharto, I., 2004, Engineering Research Methodology, Andi, Yogyakarta

[7] D. N. Usman, L. Pulungan, S. Widayati, D. Mukhsin, H. Nuryahya, and R. N. Ramadhani, "Unit Regional Genetics as a Quantitative Method for Mining Area Development Analysis," *Ethos: Journal of Research and Community Service*, vol. 10, no. 2, pp. 242-250, Jun. 2022.