Limestone Potential in Cikatomas Region Basedon Geological Maping and Its Role Towards Development of Southern Part of West Java, Indonesia

ILDREM Syafri, MURNI Sulastri, OEKE Sobarin, PUSPA Khaerani and GINANJAR Maulana

Key words: Geological Mapping, Limestone Potential, Cikatomas, West Java

SUMMARY

Geological condition of Cikatomas and surrounding area, Cikatomas District, Tasikmalaya Regency, West Java Province has interesting geological conditions to learn. Cikatomas region has variety types of limestone lithology. Related to this geological potential, this research is conducted to find out deeply about the characteristics of limestone in Cikatomas. The result of this research could become a reference of natural potential development. In the next future, this potential will be used by the surrounding community to increase the development of Southern Part of West Java region.

Research method used in this study is divided into three parts including: studio method, field survey, and laboratory analysis. The studio method is performed through the analysis of limestone types in the study area and the determination of the limestone potential. The field survey is performed by geological mapping and taking limestone samples at several locations in the study area. Laboratory analysis is done by the petrography analysis of limestone samples to determine the characteristics of the limestone type microscopically. The approach of quantitative and qualitative is performed through data analytical.

Cikatomas region is dominated by the type of clastic limestone and calcareous sandstones lithology. Based on geological condition, this can be explained by the depositional environment of Cikatomas region in the past, which can be determined as deep-sea depositional environment, experienced with lifting up process and forming of reef-limestones lithology. Based on petrographic analysis, microscopically limestone in Cikatomas region has incision color of brownish-white, there are fragments of skeletal consisting of foraminifera, fragments of non-skeletal consisting of carbonate minerals, quartz, void, and matrix of carbonate minerals. Based on the classification (Dunham, 1962) this limestone is classified in Foraminifera Wackestone group. Through the result of petrographic approach, the clastic limestone potential in this region can be exploited by local people as a building material and construction.

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1. INTRODUCTION

Geology is the science that studies about the earth, including how it occurrs, the process and the history happened until now, earth forming materials, structure of the earth, the surfaces and the history happened in the past, present, and the future.

Limestone is the word used to describe consolidated rock that formed principally by calcite mineral (calcium carbonate/$CaCO_3$). It is different from dolomite which is consolidated rock that is formed by dolomite mineral (calcium magnesium carbonate/ $CaMg(CO_3)_2$). There are some terms of the limestone such as high calcium limestone that is formed by more than 97% or 98% calcium carbonte which is very benefecial in industrial and trade (Lamar, 1965).

Limestone, commonly, is formed due to : 1. $CaCO_3$ presipitation from the water through plants and living process of animals, or water evaporation where $CaCO_3$ is too saturated and keep dissolved; 2. Skeleton accumulation or animal's shell; and 3. The combination between those two processes (McGregor, 1963).

Limestone is mostly used in many things such as industry, chemical, agriculture, and many more. In chemical industry, limestone is used as carbon dioxide gas neutralizing agent in some factories. Limestone is ideal neutralizer soil. Besides, usually limestone is also used in the metal processing such as iron, steel, and lead blent with silico dioxide and alumunium oxide to form slag known as flux (McGregor, 1963). Geology in Cikatomas Region and surroundings, Cikatomas district, Tasikmalaya residency, West Java Province has interesting condition to observe seen in lithologic type and economic aspect of the rock for development from the geology mapping. Administratively, the observation area is in the Cikatomas district, Tasikmalaya regency, West Java Province (**Figure 1**). Geographically, the observation area is placed at coordinate point of 108^o 42' 24.56" LE to 108^o 17' 51.21" LE and 7^o 39' 35.11" PS to 7^o 34' 11.35" PS.

Figure 1. Observation area location

According to van Bemmelen (1949), based on morphology and its tectonic, West Java divided into 4 physiography paths (figure 2) as presented below:

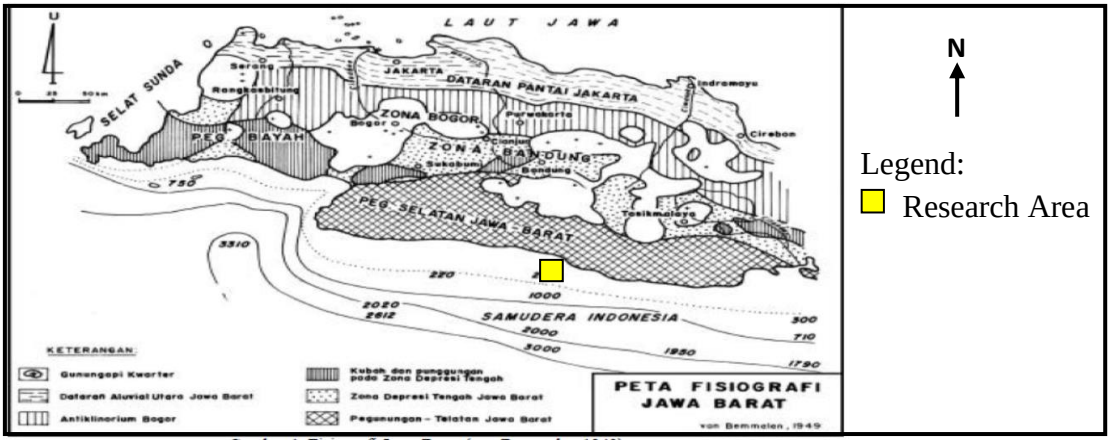


Figure 2. West Java Physiography without scale (van Bemmelen, 1949, stated in Martodjojo, 2003)

1. Jakarta Coast Land
2. Bogor Zone
3. Bandung Zone
4. West Java Southern Mountain Zone,

Based on the physiographic zone division of West Java above, the observation area is included in the Southern Mountain (see Figure 2). In the mapping area seen in Regional Geology Map of Karangnunggal Sheet are Jampang Formation, Kalipucang Formation, Pamutuan Formation, and Bentang Formation.

2. METHOD

Several methodologies that used in this research are desk work, field work, and laboratory analysis. The first is the determination of areas of research, carried out search maps DEM, DEM Withdrawal alignment, making topographic maps, and other library studies, in preparation to field. Field preparation tool for geological mapping carried out, among which: Base map scale of 1: 25,000 (used also as studio equipment), GPS devices (Global Positioning System), Compass, to perform the measurement geometry field - the field of structural geological, geological of Hummer. The main laboratory analysis done is petrography analysis.

Petrography analysis is done by cutting the rock sample into thin cut and then describing the mineral composition contained in such thin-cut rock. All mineral is described as each optical nature and calculated the percentage. The optical nature are such as crystal form, cleft, inclusion, color, pleochroism, deflect index, relief, twin, texture, zoning, orientation, extinction point, intervention color, and optical axis as well as optical signs.

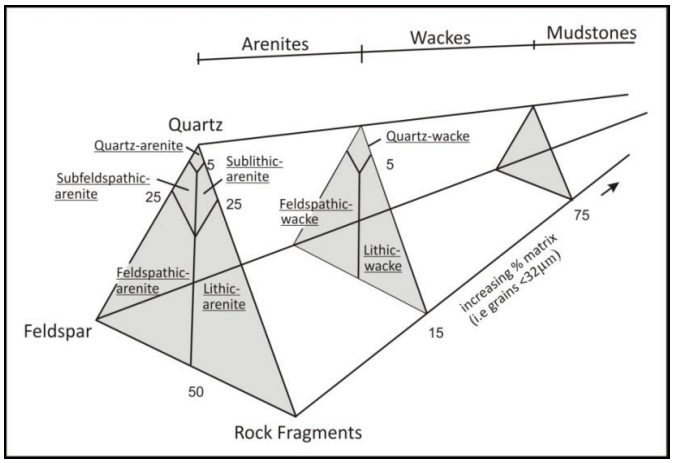


Figure 3. Sandstone Calssification by Pettijohn (1975)

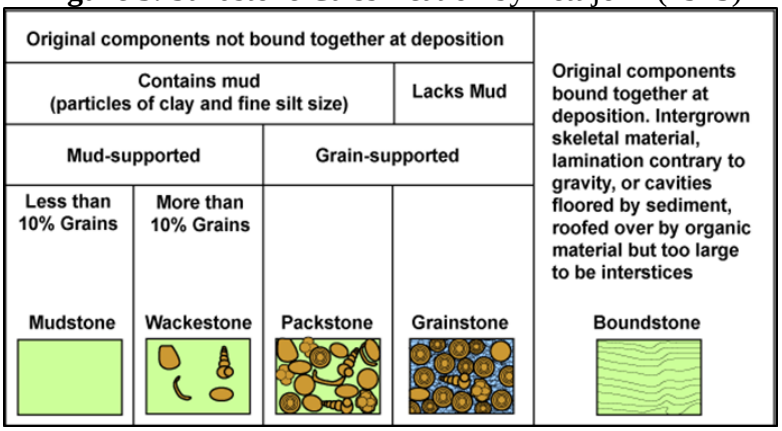


Figure 4. Limestone Classification (Dunham, 1962 dalam Bulettin AAPG)

After knowing the percentage of each material, such rock is callsified based on particular classification. For naming the rock using the classification of its inventor, for igneous using classification by Travis (1955), for naming of sedimentary rocks, Pettijohn (1975) is used, this classsification is based on fledspar contents, quartz, rock's fragment and number of matrix and cement. Pyroclastic or vulcanic rock based on the Schmid (1981) classification stated on Gillepsic & Styles (1999), based on the glass, crystal content and rock's fragment and limestone is using Dunham (1962) classification, this classification is constitued by fossil matrix, and cement content.

3. RESULT AND DISCUSSION

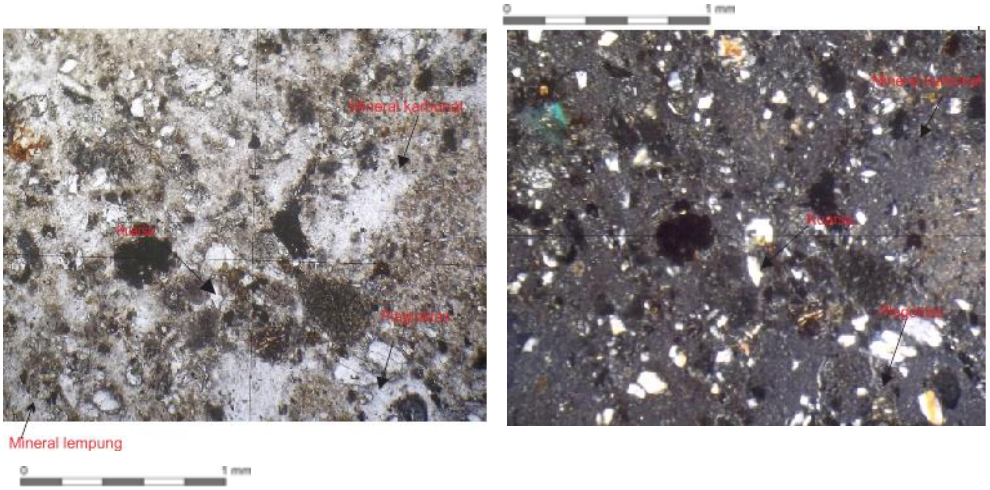
3.1 Sandstone Carbonate Unit

This Sandstone unit color is brisk black, moldered greyish black, moderate-rough granulated, the granules are moderate-round, moderately sorted, openned-cover, good-porosita, good-permeabilities, carbonatan.

Sandstone occupies the southwest and east areas of research, revealed clearly in the river Cikalapa, and show poor bedding. In the southwestern part of the unit in contact with volcanic breccia, and the eastern part of the contact with the tuff, sandstone karbonatan deployment is approximately 19% of the area of research, in the area of Ciakar river, a height of 207 meters to 308 meters above sea level.

Figure 5. Carbonate Sandstone Outcrop of 55 Station, A Long Distance Photograph, B Close Distance Photograph.

Microscopically, sandstone is composed of transparent gray incision when // - nikol and gray-brown x cros nikol, fine- grained, with bare- grained bare- angled – rounded,

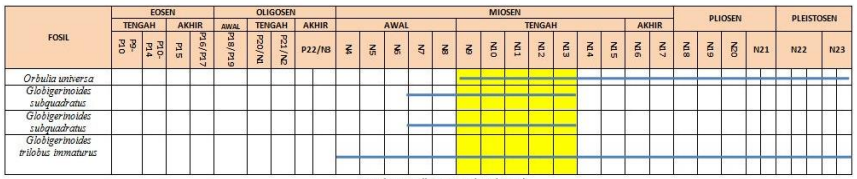


openned-cover, good sort , Crystal fragment (46%) consists of Plagioclase nineral carbonate (14%), foramifera (9%), Matrix clay minerals (45%). Based on the classification (Pettijohn, 1975) included in the group of Feldspatik wacke.

Figure 6. Sandstone Karbonatan Thin Cutlet

Age determination and sandstone depositional environment is based on the characteristics and its lithology as well as the amount of fossil formanifera and contained bentonik, and platonic fossil.

Table 1. Age Range of Planktonic Foraminifera in Sandstone Carbonate Unit (*Source : Bolli & Saunders (1985)*)



Sumber : Bolli & Saunders (1985)

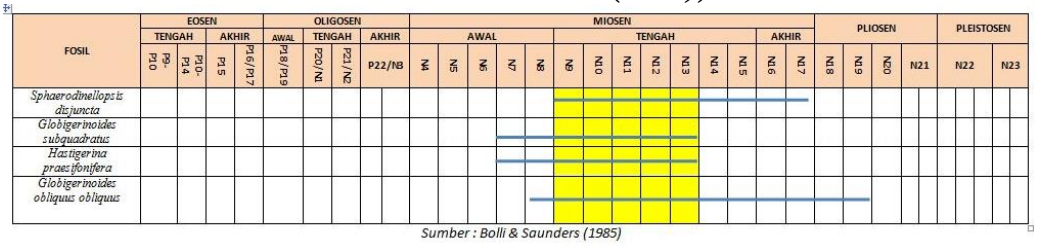
Table 2. Environmental Range of Bentonik Foraminifera Precipitation of Carbonate Sandstone Unit *(Tipsword et. al., (1966)*

TABEL LINGKUNGAN PENGENDAPAN

Kode Sampel : 35

No	No di Plate	Foraminifera Bentonik	LITORAL			NERITIK			BATIAL			ABYSAL
						Dalam	Tengah	Luar	Atas	Tengah	Bawah	
			0	10	20	50	100	200	600	1000	2000	
1	25	*Amphicoryna scalari*						•				
2	26	*Pseudorotalia conoides*				•						
3	27	*Peneroplis pertusus*					•					
4	28	*Eupatellinella ampullacea*				•						
5	29	*Globocasidulin aminima*					•					
6	30	*Operculina ammonoides*				•						
7	31	*NonIon depressum*					•					

Table 3. Age Range of Planktonic Foraminifera of Sandstone Carbonate Unit (*Source : Bolli & Saunders (1985)*)



Sumber : Bolli & Saunders (1985)

Table 4. Environmental Range Foraminifera Bentic Precipitation of Carbonate Sandstone Unit *(Tipsword et. al., (1966))*

TABEL LINGKUNGAN PENGENDAPAN

Kode Sampel : 57

No	No di Plate	Foraminifera Bentonik	LITORAL			NERITIK			BATIAL			ABYSAL
						Dalam	Tengah	Luar	Atas	Tengah	Bawah	
			0	10	20	50	100	200	600	1000	2000	
1	5	*Heterolepasubhaidingeri*						•				
2	6	*Cibicides refulgens*				•						
3	7	*Eupatellinella ampullacea*				•						
4	8	*Neouvigerinaampullacea*					•					
5	9	*Anomalinella rostrata*					•					
6	10	*Peneroplis pertusus*					•					
7	11	*Cassidelina subcapitata*					•					

Based on planktonic foraminifera fossils of some of the samples contained Globigerinoides obliquus, Hastigerina praesifonifera, Globigerinoides subquadratus, Sphaerodinellopsis disjuncta

and the southwestern also found fossils of plantonic Globigerinoides trilobus immaturus, Globigerinoides subquadratus, Globigerinoides subquadratus, Orbulia Universa.

It can be concluded east and southwest sand is the same age of the fossil age range that indicates a range of age or equivalent N9-N13 Middle Miocene.The environment from fossil foraminera bentonik to the sandstone unit in the eastern found Cassidelina subcapitata, Peneroplis pertusus, Anomalinella rostrata, Neouvigerinaampullacea, Eupatellinella ampullaceal, Cibicides refulgens, Heterolepasubhaidingeri, as well as the southwestern found also Peneroplis pertusus, Pseudorotalia conoides, Amphicoryna scalar, Eupatellinella ampullaceal, Globocasidulin aminima, Operculina ammonoides, nonionic depressumi, then based on bathymetric zone, it is known the depositional environment of the unit in the neritic environment. From the cross section reconstruction of stratigraphic position, this sandstone age has correspondence aligned with tuff unit. Tuff is deposited at the same time with karbonatan sandstone, and limestone reefs.

Based on the characteristics of lithology, sandstone karbonatan's color is fresh gray tawny color of weathered gray-black, grained medium-coarse, bare-rounded grain, moderate sorted, openned cover, good porosita, bad permeability, medium sorting, hard compactness, this sandstone unit is compared to Kalipucang (Supriatna, 1992).

Table 5. The Comparisson of Sandstone Carbonate Formation with Kalipucang (Supriatna, 1992).

Parameter	Carbonate Sandstone Unit	Kalipucang Supriatna's Formation (1992)
Lithology	fresh color of tawny gray weathered gray-black color, medium-coarse grained, bare-rounded shape grain, moderate sorted, openned cover, good porosita, good permeability, karbonatan, medium sorting, hard compactness.	Limestone is yellowish-white, medium to coarse grained, containing much large foram.
Statigraphy	Fingered with Tuff	Jampang Formation Surpression does not correspond and fingered woth the Pmutuan Tuff member
Precipitation Environment	Shallow Sea	Openned shallow sea

3.2 Reef Limestone Unit

This unit consists of a this limestone reef has fresh gray color, the color of weathered gray brown, composition dominated by shellfish such as corals that show the growth (brancing Coral and Head massive coral) and a few shells of mollusks, the matrix in the form of limemud, fair-medium sand, poor permeability, round-tough grain, hard hardness, and has a cavity.

This reef limestone unit covers the northern part of the study area, there are Jampang breccias in western and eastern contained alluvium and tuff while the southern part has a clastic limestone rock covering this reef limestone, outcrop was found in the Cipaku, Citatah and around Lengkongbarat area.

Figure 7. Reef Limestone Outcrop Stationn 69. A Long Distance Photograph, B Close Distance Photograph.

fine-grained, fragments rounded sole, pack closed, sorting ugly, consists of fragments of foraminifera (30%), and fragments of non-skeletal, mineral carbonate (5%), quartz (15%), Void (10%) and matrix (40%), based on the classification (Dunham, 1962) included into Packscone Wackestone.

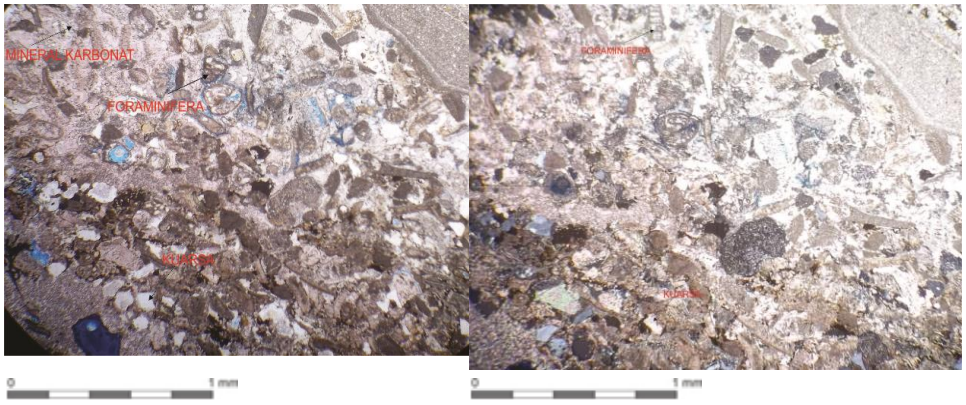


Figure 8. Thin Cutlet of Reef Limestone

In this unit, there are no fossil to determine the range of age, so to know the age, it is emphasising more on the position of statigraphy and cross section reconstruction, based on their characteristics or traits of its lithology is compared with previous investigators, based on the

position of the reef limestone, relatively younger than breccia volcanic, and from field observations and reconstruction of the geological cross section, it can be seen that this unit was deposited at the same age with karbonatan sandstone units, ranging from middle Miocene.

Based on proportionality by Surpriantna (1992), this unit is comparable with the Kalipucang formation, which the formation formed due to increasing of sea water, as well as the Tide resulting the formation of land and limestone reefs themselves usually live less than 55 meters below the sea, so that the reef itself deposited in shallow marine environments because normally reef or plants require oxygen for respiration.

Based on data from the proportionality, the author infers that the age of the reef limestone which is reef limestone of middle Miocene, in the Kalipucang Formation (Supiatna, 1992) so it is estimated that Kalipucang is the oldest formation and deposited in shallow marine environments.

Reef limestone unit with breccia can be known the statigraphy relationship and differences in the genesis and age should have known that limestone reefs is middle Miocene, while breccia Oligocene to Miocene where those Breccia in Jampang Formation which exposed at the bottom (Supriatna, 1992). From the sectional position statigraphy reconstruction, the age of reef limestone has no correspondence with early Breccia Miocene unit.

Based on the lithology characteristics, limestone reef is a reef with the appearance of massive or not showing the bedding, fresh gray color, the color of weathered gray brown, composition dominated by shellfish such as corals that show growth (brancing Coral and Head massive coral) and a little shell molluscs, limemud matrix form, medium-fine sand size, poor permeability, bare-rounded grained, hard, has a cavity.

Table 6. Coral Limestone Commparisson with Kalipucang Formation (Supriatna, 1992)

Parameter	Reef Limestone Unit	Supriatan Kalipucang formation (1992)
Lithology	Limestone reef with the appearance of massive or not showing its bedding, fresh gray color, the color of weathered gray brown, composition dominated by shellfish such as corals that show growth (brancing Coral and Head massive coral) and a few shells of mollusks, the matrix in the form of limemud, medium-fine sand size, poor permeability, tough and roundedgrained, hard, has a cavity.	Foram Limestone has brownish yellow, as well layered, and bad partially plated
Stratigraphy Position	Surpressing in not corresponding breccias	Surpressing Jampang Formation in no corresponding
Precipitation Environment	Shallow sea and nerritic environment	Shallow and openned sea

3.3 Clastic Limestone Unit

This limestone unit is composed of clastic limestone, clastic limestone has fresh white color, faded white color of obsolete, the composed by fragments of shells and matrix. Fragments of shells in the form of shell fragments of coral and mollusks, limemud matrix, fine-medium sand sized, bare-rounded grain shape, poor permeability, hard.

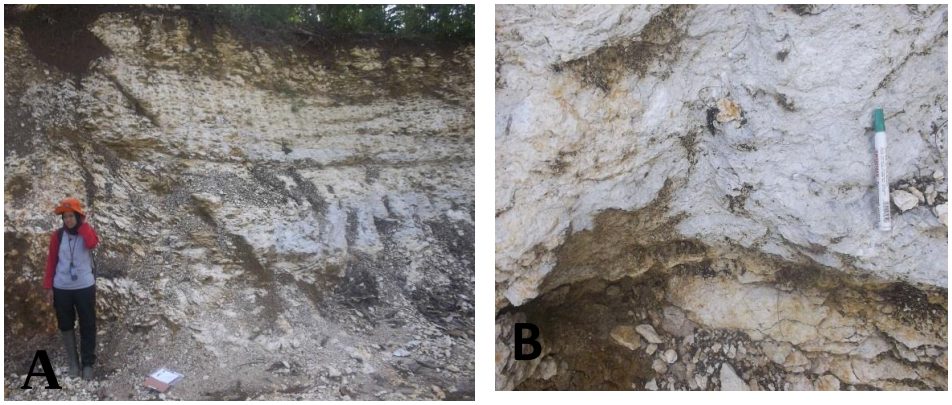


Figure 9. Clastic Limestone outcrop Station 53 A Long distance, B close distance.

Microscopically, the cutlet of clastic limestone is pure white, Fragment Skeletal consists of foraminifera (30%), fragments of Non-Skeletal 30%, consisting of mineral karbonatan (45%), quartz (15%), Void (10%), matrix minerals karbonatan (40%), based on the classification (Dunham, 1962) belongs to a generation of rock Foraminifera Wackestone

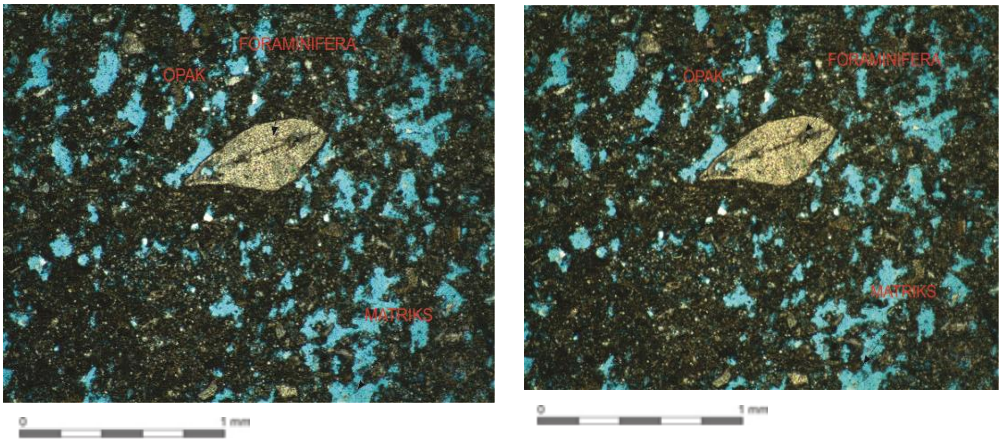
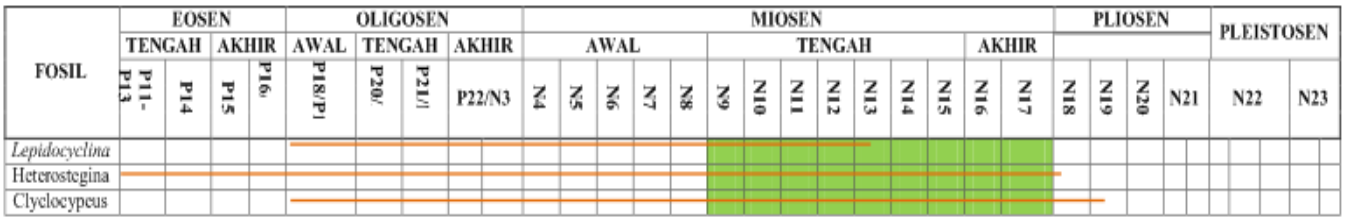


Figure 10. Thin Cutlet of Clastic Limestone

This limestone unit occupies the southeast to the southern part of the study area, surrounding this clastic limestone unit there is no contact with the sandstone karbonatan. These outcrops are found in the area Cogrek and Cibatu and tributaries. Spread about 23% of the research area, with a height of 291 meters to 307 meters above sea level. Age determination and depositional environment of clastic limestone is found based on the characteristics and lithology as well as large number of fossil foraminifera.

Table 7. Age range of clastic Limestone zone unit Station 57 Based on Large Foraminifera contained



(Source : Bolli & Saunders (1985))

Based on the large foraminifera fossils of thin section obtained in clastic limestone unit Lepidocyclina, Heterostegina and Clyclocypeus, it can be concluded that this clastic limestone has a lifespan that span the length of the Late Oligocene to Miocene, but the author took on Middle Miocene to the Late Miocene. The environment from fossil foraminera of this great clastic limestone unit, as well, was found in shallow marine depositional environment, because typically large foraminifera must have enough sunlight for life.

Statigraphy position of the cross section reconstruction of clastic limestone age is estimated that fills syncline at karbonatan sandstone, limestone clastic itself deposited during the Middle Miocene to the Late Miocene.

Based on the characteristics of clastic limestone litologinnya has fresh colors-white, off-white color of obsolete, has a composition in the form of fragments of shells and matrix. Fragments of shells in the form of shell fragments of coral and mollusks, matrix form limemud, fine and moderate sand sized, tough-rounded grain, poor permeability, has mineral aronit, very hard, this sandstone unit is compared to Landscape Formation (Supriatna, 1992).

Southern Mountain area of West Java in Karangnunggal Section has started since the Miocene below. The lifting occurred on Oligo-Miocene causing volcanic activity that results in formation of Jampang has environment which is deep and openned ocean. Towards the end of Early Miocene volcanic activity occurs in different way, resulting in sediment interval get dacite volcanic structure, smooth clastic, and carbonates. Breakthrough dacite estimated to occur in this stage.

In the early Middle Miocene, the area is stable, volcanic activity is slowing down, and limestone formations of Kalipucang began to form. Sedimentation of Kalipucang Formation followed by carbonated clastics, and tuffs napalan. Pamutuan Formation is in the shallow and the opened sea but, in the middle Miocene, the area experienced strong tectonic accompanied by granodiorite and breakthrough folded rock, partially sorted and weak. Rocks are affected to this process of lithology primarily Jampang formation that are clorided and propilited. While limestone Kalipucang formations partially transformed into marble. At the beginning of the late Miocene occurred in genang sea volcanic activity followed by producing clastic sediments containing volcanic spices, which make up Landscape Formation.

Table 8. Clastic Limestone Unit comparrisoon with Landscape Formation (Supriatna, 1992)

Parameter	Clastic Limestone Unit	Landscape Formation (Supriatana, 1992)
Lithology	Clastic Limestone with the appearance showed no coating field. Fresh-white color, faded-white color of obsolete, has a composition in the form of fragments of shells and matrices. Fragments of shells in the form of shell fragments of coral and mollusks, limemud matrix form, fine-medium-sized sand, bare-rounded grain, poor permeability, hardness is rather hard.	Limestone has bright yellow color, contains a lot of small foraminifera and corals
Statigraphy Position	Surpressing Kalipucang Formation and Pamutuan in alligned.	Surpressing Kalipucang Formation and Pamutuan not in alligned.
Precipitation environment	Shallow and neritic sea environment	Neritic precipitation environment

Plio-Pleistocene tectonics began with the appointment followed that occurred in the Pliocene and followed by volcanic activity. (Presumably one source is G. Cikuray). Folding allegedly occurred after. In the quarter, the region as a whole has become the mainland with the deposition of alluvium in the form of river and coastal sediment caused by erosion and deposition process that continues until today.

3.4 Limestone in Cikatomas Potency

Distribution of limestone composed nearly 65% of the study area. Limestone is located in diverse regions composed of clastic limestone, reef limestone and sandstone limestonean. Each of these rock types has a different composition of calcium carbonate. The level of calcium carbonate limestone composition is influence so much on treatment utilization of limestone that can be done.

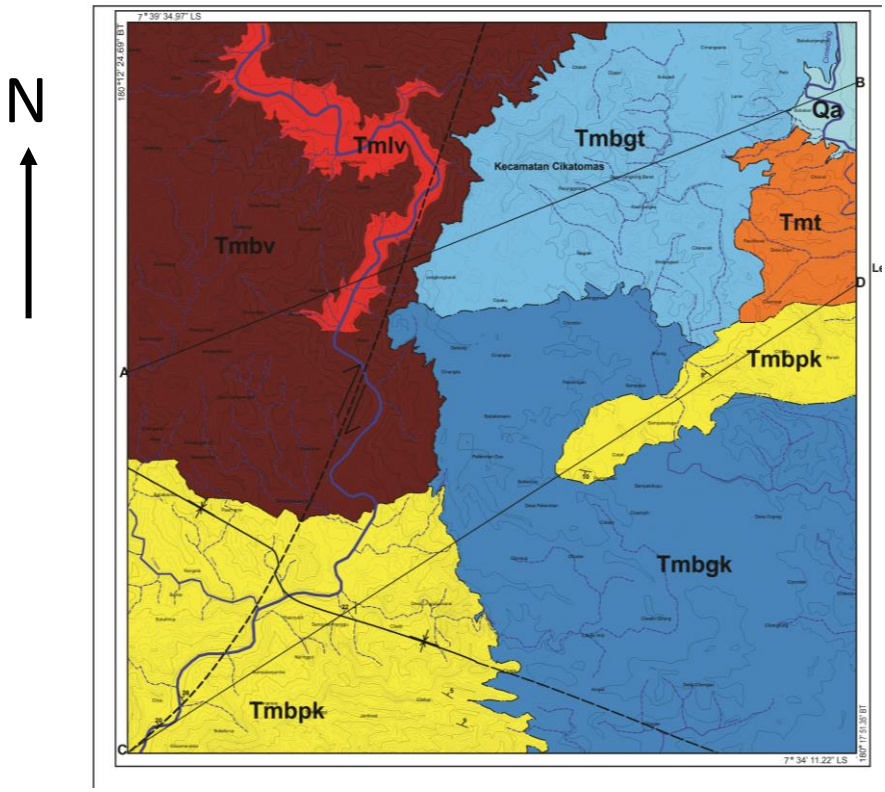


Figure 9. Map limestone Cikatomas

Minerals in the study area are pretty much in the form of limestone. Limestone widespread in the study area used by locals to be used as the foundation of the house and the base path and there are also people who use limestone as lime.

Figure 10. Limestone Mining

Mining activities undertaken by this population is still in traditional way with activities in accordance with needs. This potency has not been optimally utilized by the people. Maximum utilization can increase incomes in the Cikatomas region that automatically increase local revenue.

As is done in the United States generally limestone used as raw material for Portland Cement, breakfast cereals, paints, calcium supplement pills, marble tables, antacid tablets, high-quality paper (Bliss, Hayes, and Orris, 2012).

However, research on the potency of limestone in Cikatomas needs to be studied further, especially in terms of mineral composition of calcium carbonate and calcium magnesium carbonate. Because generally limestone that has commercial value is limestone which is rich in calcium (high-calcium limestone).

REFERENCES

Bliss, James D., Hayes, Timothy S., and Orris, Greta J. 2012. Limestone – A Crucial and Versatile Industrial Mineral Commodity. USGS, Science for Changing World.

Lamar, J. E. 1965. Uses of Limestone and Dolomites. United State: State of Illinois, p. 3.

Boggs Jr, Sam. 1987. *Principle of sedimentology and stratigraphy, 2nd Edition*, Prentice Hall, Inc, New Jersey.

Dunham, R.J., 1962. *Classification of Carbonate Rocks according to Depositional Texture*, in Ham, W.E. ed., *Classification of Carbonate Rocks:* American Association of Petroleum Geologist Memoir I, p. 108-121. Geological Society of America. 2009. *Geologic Time scale.*

Feunty, M.J., 1964. *The Description of folt. Geologi Association of America*.Bulletin

Himpunan Mahasiswa Geologi. 2009. *Geologi Dasar*. Geologi UNPAD. Tidak diterbitkan

Loeblich and Tappan. *Foraminifera of the Sahul Shelf and Timor Sea.*

Marle, van, L.J, 1991. *Eastern Indonesian, Late Cenozoic, Smaller Benthic Foraminifera*. Geomarine Centre, Institute of Earth Science, Urije Universiteit, Amsterdam.

Martodjojo, S. 2003.*Evolusi Cekungan Bogor Jawa Barat* Tesis Doktor, Pasca Sarjana. ITB Bandung.

Pettijohn, F.J. 1975. *Sedimentary Rocks*. Third Edition. Harper & Row Publishers, New York-Evanston-San Fransisco-London.

Schmid, R. 1981. *Descriptive nomenclature and classification of pyroclastic deposits and fragments*. Recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks.

Supriatna, dkk, 1992.*Gelogi Daerah Karangnunggal*,Skala 1:100.000 Ditjen Geologi dan Sumberdaya Mineral,Pusat Penelitian dan Pengembangan Geologi , Bandung

Travis, Russell B. 1955. *Classification of Igneous Rocks*. Colorado School of Mines Vol. 50, No.1.

Walker, R. G. dan Noel P.James, 1992. *Facies Models – Response To Sea Level Change*. Love Printing Service Ltd. Stittsville, Ontario.

van Marle, L. J. (1991). *Eastern Indonesian Late Cenozoic Smaller Benthic Foraminifera*. Marine & Petroleum Geology, 8(1), 22-34.