Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

Characteristics of Limestone Formation Tonasa in Baring Area Segeri District Pangkep Regency South Sulawesi Province

Muhammad Adam[1]*, Hasanuddin[2], Yunita Samalembang[3]
[1-3]Department of Geological Engineering, Faculty of Mining and Earth Engineering,
Bosowa University, Makassar, Indonesia
Correspondence e-mail: adammuh1974@gmail.com

ABSTRACTS

Administratively, the Baring area is included in the area of Segeri District, Pangkep Regency, South Sulawesi Province. This study aims to determine the characteristics of the Tonasa Formation limestone. The research method is the method of observation and collection of field data and the petrographic method.The Baring area geomorphological unit is a geomorphological unit of low karst hills characterized by the presence of karst cliffs, staclactites and karst caves. Periodic and episodic river types, subsequential river genetic types, river stadia are young towards adulthood and adult area stadia towards adulthood. Characteristics of the appearance of limestone of the Tonasa Formation macroscopically in a fresh state of brownish-yellow and in a weathered state of blackish-gray, clastic texture, size of fine sand material to medium sand, unlayered structure, good sortation, closed packaging, good porosity, good permeability. And microscopically, it shows a massive structure and texture of low porosity, grain supported, 0.02 – 0.75 mm, the constituent fragments in this rock are in the form of skeletal grains/clast/fossils, minerals in the form of calcite are found with a size of 0.02 mm – 0.15 mm, mud is found replacing and filling body parts of fossils that have undergone dissolution with a size of <0.02 mm.

https://doi.org/10.58227/jge.v4i1.222

ARTICLE INFO

Article History:
Received 28 Mar 2025
Revised 02 Apr 2025
Accepted 27 Jun 2025
Available 30 Jun 2025

Keyword:
Baring, Characteristics, Limestone, Tonasa Formation

INTRODUCTION

Administratively, the Baring area, Segeri District, Pangkep Regency, South Sulawesi Province, and geographically, this area is located at the coordinate points of 119o37'00" E-119°40'00"E and 04°39'00" S – 04°42'00" S. Geologically, the Baring area is located in the northern part of the country, there are two areas characterized by karst topography formed by the limestone of the Tonasa Formation. These two karst topography areas are separated by mountains, which are composed of volcanic rocks dating from the Lower Miocene to the Pliocene. The West Coast is a lowland that consists mostly of swamp areas and tidal areas, several large rivers form flooded areas in this plain. In the eastern part, there are isolated hills composed of Miocene Pliocene volcanic clastic rocks (Sukamto, 1982). The West Coast is occupied by a low elongated hilly morphology with a general northwest-southeast direction. This area is composed of carbonate rocks from the Tonasa Formation (Sukamto, 1982).

Tonasa Formation (Tmpt) solid coral limestone, partially blurred, white and light gray; bioclastic limestone and calcarenite, white, light brown and light gray, partially layered, interspersed with napal Globigerina tufaan; The bottom contains bitumen limestone, locally inserted limestone breccia and sandstone limestone; in the Ralla area, limestone containing a lot of schist fragments and ultramafic rocks were found; Layered limestone partly contains many small foraminifera and some layers of sand napal contain many large clams (pelecypods) and snails (gastropods). Solid limestone is generally strongly corroded; in the Tanete Riaja area, there are three nape paths that intersect with layered limestone paths (Sukamto, 1982).

The age of the Tonasa Formation is Upper Eocene to the Middle Miocene (Sukamto and Supriatna, 1982, in Bhakti, 2003) the sedimentation environment is shallow to deep and lagoon. The thickness of the Formation is estimated to be not less than 3000 meters, overlapping the rocks of the Mallawa Formation, and being crushed out of alignment by the Camba Formation, broken through by sills, hacks

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

and igneous rock stocks composed of basalt, tractite and diorite. The Tonasa Formation limestone has been divided into 5 sections based on its fasies. Blue Area of Bone Regency, Ralla Area of Barru Regency, Central Area of Pangkep Regency, Pattunuang Asue Area of Maros Regency and Nassara Area of Jenneponto Regency. The ralla area is composed of redeposited fasies consisting of fragmental limestone interspersed with napal, in some places showing limestone with large foram components, algae and coral. (Sukamto, 1982).

The research area is mapped in the main structure in the Pangkajene and Watampone Sheets of the Western Part. The tectonic process in the western part lasted from the Triassic to the Late Early Miocene volcanic activity was followed by tectonics which caused the beginning of the Walanae Formation which then became the basin where the Walanae Formation formed. The decline of the Walanae fault is limited by two normal fault systems, namely the Walanae fault and the Soppeng fault. (Sukamto, 1982).

This research is related to the characteristics of the Tonasa Formation limestone in the Lappajuara area. The Tonasa Formation, which consists of Limestone, is widely spread in the South Arm of Sulawesi, currently its use is more widely used as a material for the cement industry and limestone that has not been metamorphized is perfectly used as a marble industrial material. Research on the characteristics of limestone in the Tonasa Formation is expected to obtain new information related to the use of limestone other than as cement and marble.

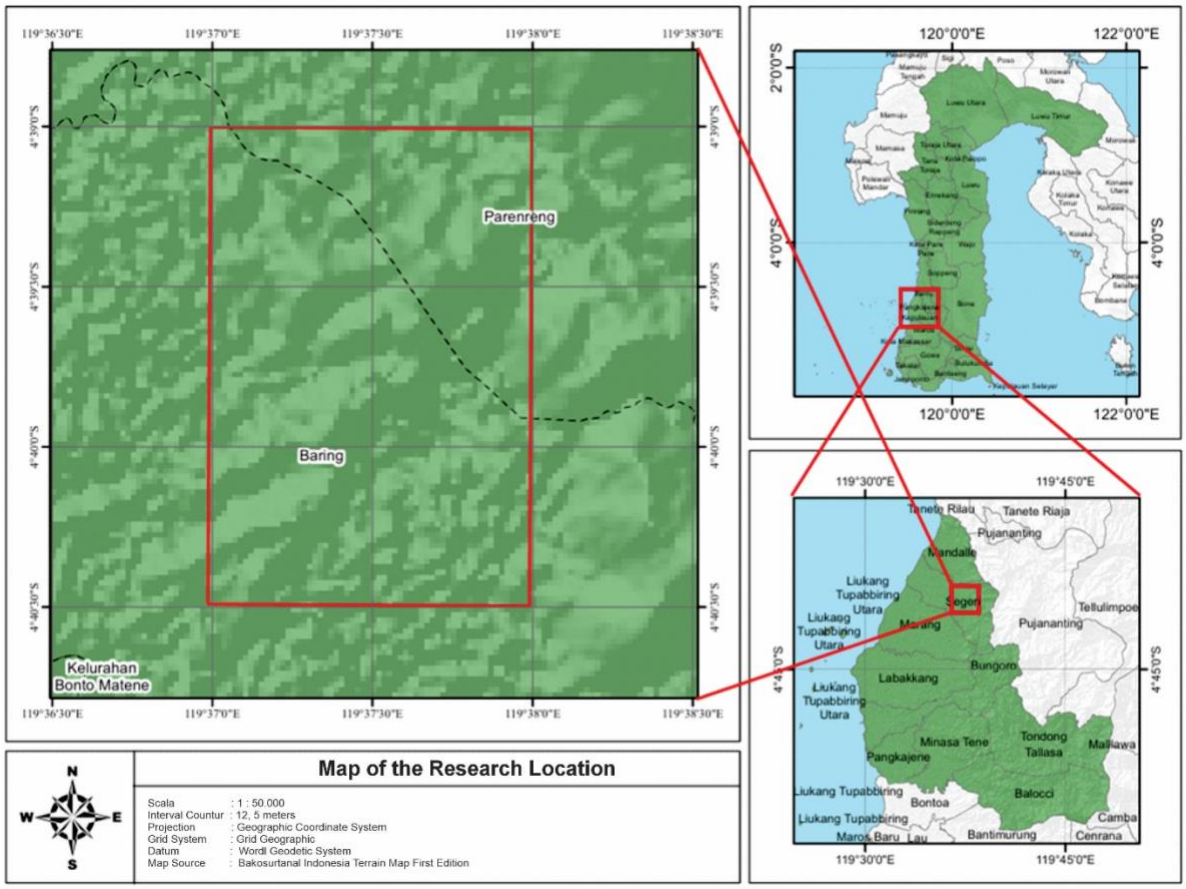

Figure 1. Map of the research location

METHODS

Field Data Collection Comprehensive field data collection was carried out at each rock outcrop in the study area. This process includes several important steps:

1. Geomorphological Observations: Observing the surface features and geomorphological characteristics of the Baring area. This includes analyzing topography, river flow patterns, and other landforms that can provide clues about past geological processes.
2. Lithological Type Observations: Identifying and recording the types of rocks found at each outcrop. This involves visual observation and detailed descriptions of the color, texture, and structure of the rocks.

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

3. Geological Structures: Observing and recording geological structures such as folds, faults, and joints present in the outcrops. These structures provide important information about geological deformation and the tectonic history of the area.
4. Outcrop Dimensions: Measuring the dimensions of the rock outcrops, including length, width, and height (Nawir, Thamsi, Sanjaya, et al., 2023). This data is crucial for understanding the scale and distribution of basalt rocks in the study area.
5. Presence of Basalt Rocks: Identifying and recording the presence of basalt rocks at each outcrop. This includes observing the physical characteristics of the basalt rocks such as color, texture, and mineralogy.

Petrographic Analysis

Petrographic analysis is conducted to determine the mineral composition and texture of the basalt rocks. The steps in petrographic analysis include:

1. Sample Preparation: Collecting basalt rock samples from the field and preparing them for laboratory analysis. The samples are cut into thin sections that can be observed under a petrographic microscope.
2. Microscopic Observation: Using a petrographic microscope to observe the thin sections of the rocks. This observation includes identifying minerals, analyzing textures, and determining the relationships between minerals in the rocks.
3. Mineral Composition: Determining the mineral composition of the basalt rocks. This involves identifying the main and accessory minerals and conducting quantitative analysis to determine the percentage of each mineral.
4. Rock Texture: Analyzing the texture of the rocks, including grain size, grain shape, and the relationships between grains. The texture of the rocks provides information about the formation conditions and thermal history of the basalt rocks.

RESULTS AND DISCUSSION

Geology of the Baring area

The geomorphological unit of the Baring area has an altitude of about 62.5-137.5 meters above sea level, has low hill reliefs, peak shape and "V" to "U" valley shape as a result of the dissolution and erosion process. From the morphogenesis approach, this research area is analyzed on the characteristics of natural formations as a result of processes that change the shape of the earth's surface destructively influenced by weathering and erosion processes. From the morphogenesis approach, this research area is analyzed on the characteristics of natural formations as a result of processes that change the shape of the earth's surface destructively influenced by weathering and erosion processes. This landscape is controlled by its easily soluble constituent rock, namely limestone.

In this unit, the weathering process that occurs is dominated by high chemical weathering in the form of dissolution as shown on karst cliffs, In addition, stalactites are also found which are the result of the dissolution process, small caves and also underground rivers, In addition to chemical weathering, biological weathering also plays an important role in the formation of this unit.

The lithology that makes up this geomorphological unit is limestone. Land use in this geomorphology is rice fields and bush forests. The types of rivers are periodic rivers and episodic rivers. The genetic type of the river is subsequential, where this river has a river flow direction relatively parallel to the movement of rock layering. River stadia are young river stadia before adulthood and area stadia is mature before old.

The limestone unit extends from north to southwest which occupies the Parenreng to Baring area. This unit was well exposed and in a fresh condition. The determination of the thickness of this unit uses the geological cross-section of the A-B incision by measuring the lower and upper limits of the layer on the geological cross-section, so that the thickness of the limestone unit is approximately + 42.5 meters.

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

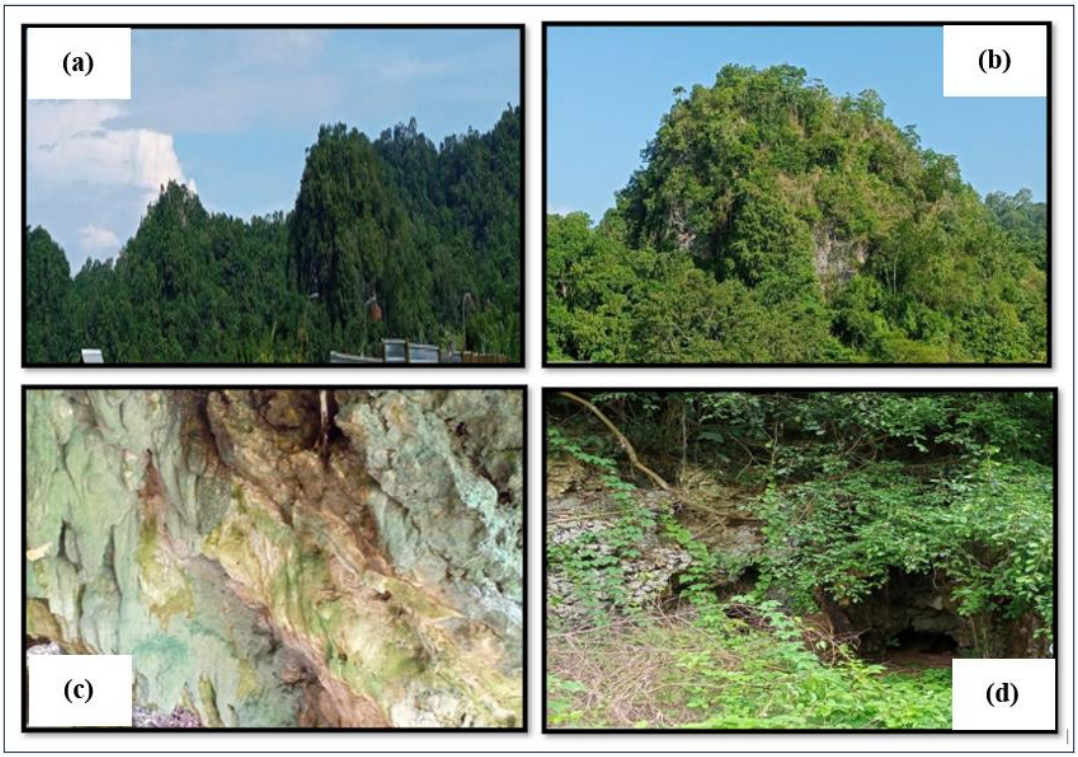

Figure 2. (a) karst hills (b) karst cliffs (c) stalactites (d) karst caves

The determination of the age of the limestone unit is determined relatively based on the geographical location, stratigraphic position and the comparability of lithological characteristics with other official limestone units, which in this location is generally composed of coral limestone, bioclastic limestone and calcarenite, mostly solid and layered, inserted naples, shale and sandstone at the bottom which are included in the rock members of the Tonasa Formation (Temt). Based on the similarity of physical characteristics and geographical location, the units of the Tonasa Formation (Temt) which show age range from the Early Eocene to the Middle Miocene (Sukamto and Supriatna, 1982).

Characteristics of Limestone of the Baring Area

Limestone lithostratigraphy research based on field observations and literature studies is included in the Tonasa Formation with groups in non-clastic sedimentary rocks. Meanwhile, based on the analysis of lithological petrographs in the research area in the form of packstone and mud limestone. The research location is a low karst hilly area, this is based on geomorphological observations around the research site. These low karst hills are widespread, characterized by undulating hills with the shape of blunt peaks. The limestone hills are generally conical in shape and are characterized by a moderate - high level of vegetation.

Megascopically, it is carried out by directly observing the physical properties and composition of minerals, which then uses the classification of carbonate rocks based on clastic and non-clastic textures by Selley (1976) in Endarto (2005). Meanwhile, microscopic analysis using polarizing microscopes for the observation of the physical and optical properties of minerals as well as specific description of mineral composition in thin section samples. This petrographic observation uses the classification of carbonate rocks according to (Dunham. 1962). The rock that makes up this unit is limestone. Megascopically, the appearance of limestone in a fresh state is brownish-yellow and in a weathered state is blackish-gray, clastic texture, the size of fine sand material to medium sand, unlayered structure, good sorting, closed packaging, good porosity, good permeability.

The microscopic appearance of limestone station 1 observation was performed in a 10x magnification of the eyepiece and a 5x objective lens with a total magnification of 50x. In general, the incisions show a massive structure and low porosity texture, grain supported, 0.02 – 1.35 mm, the constituent fragments in this rock are in the form of skeletal grain/clast/fossils (70%), minerals in the form of calcite (10%) with a size of 0.02 mm – 0.15 mm, mud (20%) with a size of <0.02 mm as a binder between grains, which are found to replace and fill body parts of fossils that have undergone dissolution.

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

Based on its physical properties and material composition, the name limestone is Packstone (Dunham, 1962).

Figure 3. Limestone lithological appearance ostation 1 is pictured to the southwest (N 225° E)

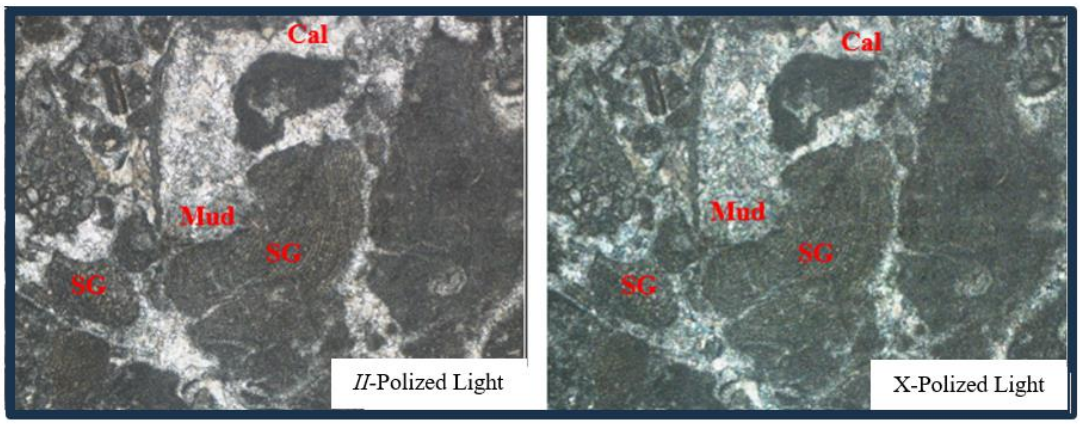

Figure 4. Microscopic appearance at station 1, with mineral composition consisting of skeletal grain (SG), calcite (Cal) and mud

Petrographic appearance of limestone units at station 2, observations were made in 10x magnification of the eyepiece and 5x objective lens with a total magnification of 50x. In general, the incisions show a massive structure and texture of low porosity, grain supported, 0.02 – 0.75 mm, the constituent fragments in this rock are in the form of skeletal grain/clast/fossils (65%), minerals in the form of calcite (5%) with a size of 0.02 mm – 0.15 mm, mud (30%) is found replacing and filling body parts of fossils that have undergone dissolution with a size of <0.02 mm. Based on its physical properties and material composition, the name limestone is Packstone (Dunham, 1962).

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

Figure 5. Photo Appearance of Limestone Outcrop Station 2 photographed to the southwest (N 260°E)

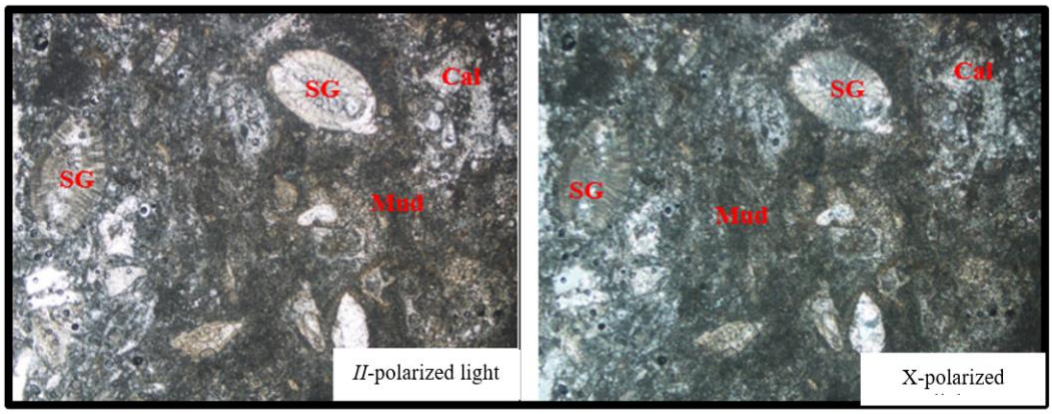

Figure 6. Petrographic appearance of Limestone on Station 2 with a mineral composition consisting of from the mineral calcite (Cal), skeletal grain (SG) and Mud

The megascopic appearance of the limestone found at station 3, found in fresh conditions shows brownish-white physical characteristics and in a weathered condition of blackish-gray, this rock is classified as a non-clastic carbonate sedimentary rock, has a massive structure, the mineral that can be observed megascopically is the mineral calcite.

Journal of Geology & Exploration
Vol. 4, No. 1, June 2025 : 15 – 22
E-ISSN 2963-2869

Figure 7. Photo Appearance of Limestone Outcrop Station 3 photographed to the east and west (N 97°E)

Petrographic appearance of limestone unit station 4 Observations were made in 10x magnification of the eyepiece and 5x objective lens with a total magnification of 50x. In general, the incision shows a blackish-brown absorption color and a purplish-blue to brownish-red interference color, massive structure and low porosity texture, mud supported, grain size 0.02 – 0.75 mm. The constituent fragments in this rock are in the form of skeletal grain/clast/fossils (5%) and minerals in the form of calcite (20%) with a size of 0.02 – 0.2 mm, mud (75%) is found replacing and filling body parts of fossils that have undergone dissolution with a size of < 0.02 mm. Based on its physical properties and material composition, the name of limestone is Mudstone (Dunham, 1962).

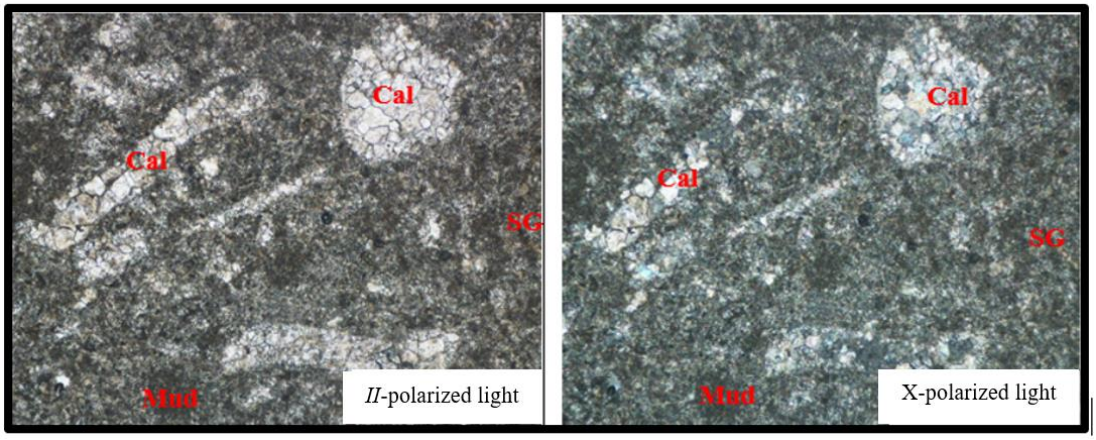

Figure 8. Petrographic appearance of limestone at station 4 with mineral composition consisting of calcite minerals (Cal), skeletal grain (SG), and mud (Mud).

CONCLUSION

The Baring geomorphological unit is a geomorphological unit of low karst hills characterized by the presence of karst cliffs, staclactites and karst caves. Period and episodic river types, subsequential river type, river stadia are young towards adulthood and adult area stadia towards adulthood. Characteristics of the appearance of limestone of the Tonasa Formation macroscopically in a fresh state of brownish-yellow and in a weathered state of blackish-gray, clastic texture, size of fine sand material to medium sand, unlayered structure, good sortation, closed packaging, good porosity, good

permeability. And microscopically, it shows a massive structure and low porosity texture, grain supported, 0.02 – 0.75 mm, the constituent fragments in this rock are in the form of skeletal grains/clasts/fossils (65%), minerals in the form of calcite (5%) with a size of 0.02 mm – 0.15 mm, mud (30%) is found replacing and filling body parts of fossils that have been dissolved with a size of <0.02 mm.

ACKNOWLEDGMENT

The author would like to express his gratitude and highest appreciation to the head of the geological engineering study program, faculty of engineering, university for his permission and support in carrying out and completing research in the Baring area, Pangkep Regency, South Sulawei Province.

REFERENCE

Bauman, P., 1971. *Summaries of Lectures in Larger Foraminifera*, Departement of geology, LEMIGAS, Jakarta.

Billings, M.P., 1968. *Structural Geology*, Second Edition, Prentice-Hall of India Private Limited, New Delhi.

Cushman, J. A., 1983, an *Illustrated Key to the Genera of the Foraminifera*, Sharon, Massachusetts, U.S.A.

Darman, H and Hasan, S., 2000. *An Outline of The Geology of Indonesia*, Indonesian Association of Geologists, Indonesia.

Dunham, R. J., 1962. *Classification of Carbonate Rocks According to Deposition Texture,* dalam *Classification of Carbonate Rocks* (ed. W.E.Ham), pp 108-121. Mem. Am. Ass. Petrol. Geol. (1) Tulsa, USA.

Grabau, A., 1904. On *The Classification of Sedimentary Rocks.* Am. Geologist,33:228-247.

Hallsworth, C R, and Knox, R W O'B, 1999. *BGS Rock Classification Scheme Volume 3 Classification of Sediments and Sedimentary Rocks*, British Geological survey research report, RR 99-03.

Kerr, P.F., Ph.D., 1959. *Optical Mineralogy.* Third Edition, McGraw-Hill Book Company, New York, Toronto, London.

Loeblich. A.R., and Tappan. H., 1988, *Foramineferal Genera and Their Classification-Plates*, Von Nostrand Reinhold, New york.

Longman, M., 1980. *Carbonate Diagenetic Texture from Nearsurface Diagenetic Enviroments.* Oklahoma: American Association of Petroleum Geologist.

Pettijohn, F., 1975. *Sedimentary Rocks 3rd Edition.* New York: Harper and Row.

Ragan, D.M., 1973. *Structure Geology An Introduction to Geometrical Tecniques*, Second Edition, Departement of Geology Arizona State University.

Sukamto, R., 1975. *The Structure of Sulawesi in the Light of Plate Tectonics.* Jakarta: Paper presented in the Regional Conferences of Geology and Mineral Resources Sountheast Asia.

Sukamto, R. 1982., Geologi Lembar Pangkajene dan Watampone bagian Barat. Pusat Penelitian dan Pengembangan Geologi Direktorat Pertambangan Umum Departemen Pertambangan Dan Energi, Bandung, Indonesia.

Thornbury, W.D., 1954. *Principles of Geomorfology*, John Billey and Sons Inc., Landon, New York, Sidney.

Travis, R.B., 1955. *Classification of Rock*, Colorado School of Mines, Volume 50

Tucker, M. E., and Wright, V. P., 1990, *Carbonate Sedimentology*, Blackwell Scientific Publications, London.

van Bammelen, R. W., 1949. *The Geology of Indonesia.* Vol IA. The Hague, Government Printing Office

van Leeuwen, T.M., 1981, *The Geology of Southwesth Sulawesi with Special Reference to The Biru Area*, In: Barber, A.J & Wiryosujono, S. (eds), The Geology and Tectonics of Eastern Indonesia, Geological Research and Development Centre, Bandung, Spec. Publ., No.2, hal. 277-304.

van Zuidam, R.A., 1985. *Aerial Photo-Interpretation In Terrain Analysis and Geomorphologic Mapping*, Smits Publisher The Hagne, Netherlands.

Wilson, M.E.J., 1995, *The Tonasa Limestone Formation* Sulawesi, Indonesia : *Development of a Tertiary Carbonat Platform*, *Unpublished*, PhD Thesis, University of London