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Grain Size Analysis of Quaternary Sediment from Kendari Basin, Indonesia

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Abstract: ***Kendari basin is a geomorphological unit, which is bounded by a ridge as the product of tectonic. It can be classified as inter fault-scarp basin. There are 20 samples taken with random sampling method along the watershed Wanggu. Sedimentary samples from Kendari basin are moderately well sorted to poor sorted, dominant coarse skewness to very coarse skewness, and very platycurtic to very leptocurtic. Based on the frequency distribution of the grain size of the sediment, generally samples of sediment from the river order 1 shows the appearance of bimodal. Mean phi shown grain size between coarse to moderatly, Sortation dominant poorly sorted, with skewness negative and kurtosis dominant platycurtic. Multivariate statistical analysis it appears that sediment samples are strongly influenced by the activity of the river.***

Keywords: Granulometry, Quaternary, sediment, river, Kendari basin

1. Introduction

Granulometry analysis is an analysis of the sediment grain size. This analysis is generally performed to determine the level of resistance against the grain sediment exsogenic processes. For examples are weathering, erosion, and abrasion of provenance, as well as transport and deposition processes. Those things are an important variable in making an interpretation. The resistance level of a rock can be seen on the grain size. Processes of exogenic will change the shape and size of a sediment particle. While the transport and deposition processes show how the process of moving the primary agents such as water and sediment grains precipitate. According to Boggs [1], there are three factors that affect the size of grains of sedimentary rocks, namely sediment grain size variations of origin, transport processes, and energy deposition. Data of sediment grain size analysis results are used to determine the 3 factors clearly.

Shepard has distinguished beach sand from dune and from river sand. Texturally, the river sediments are sandy silt and are coarse grained, whereas in estuary the sediments are clayey silt and fine grained [2]. Geologists and sedimentologists use information on sediment grain size to study trends in surface processes related to the dynamic conditions of transportation and deposition.

The average of grain size reflects the characteristics of energy deposition by water or wind in sediment transport. The spread of grain size frequency is highly dependent on the depositional environment. The grain size coarser and more finely dispersed on the right and left in the same amount. If the grain size distribution of excessively coarse particles, then skewness is negative and vice versa, when the grain size distribution of the fine particles excessively skewness is positive [3].

2. Material and Method

Kendari basin is a geomorphological unit, which is bounded by a ridge as the product of tectonic [5]. It can be classified as inter fault-scarp basin. Kendari basin plain surrounded on the north side there are Nipa-Nipa Mountains, the east by Abeli hills, on the south side there are Wolasi mountains and western side there are Bondoala hills. Geographically, Kendari basin extending from North to South 03°54'30" until 4° 3'11" S and stretches from west to east between 122°23' and 122 ° 39 'E (fig.1).

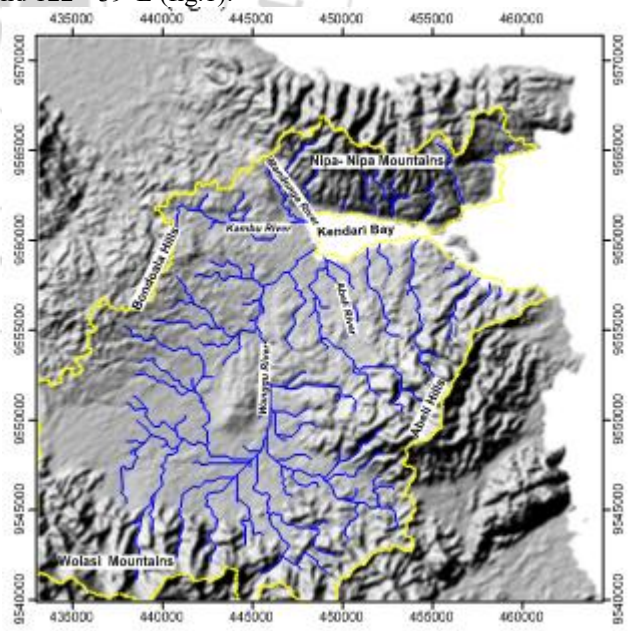

Figure 1: Physiography of Kendari basin

In the Kendari basin there are found also morphological Kendari Bay. Siltation of Kendari Bay is indeed difficult to overcome, because in addition to Wanggu River which empties into the Gulf of Kendari. There are about 10-13 other rivers that empty into the Gulf of Kendari. Those rivers include Mandonga river, Kambu river, Abeli river, Lasolo

river and others 13 more rivers who also contributed to the sediment particles in Kendari Bay.

Geology and stratigraphy of the basin Kendari dominated by metamorphic rocks and sedimentary rocks of group Formation Meluhu (TRJt), Molasa Sulawesi (Tmpp), Formation Alangga (QPA) and alluvium (Qa), as well as the local limestone coral old Quarter known as Formation Buara (fig. 2).

Alluvium (Qa) is the youngest sediment, consisting of mud and loose material sized clay, sand, until gravel. These deposits are at several points around the city of Kendari, especially around the Wanggu River which empties into the Gulf Kendari. The mud colour is dark gray to reddish brown. While clay brown to reddish brown or light gray, interspersed with sand, and gravel. Formation Alangga (QPA) consists of sandstones and conglomerates. The rock group is a group of Sulawesi molasa deposited at the end of the plate collision. Various fragments in this formation are found from silica, clay, sandstone, up to availability of iron oxide. The existence of iron oxide becomes one identifier of this formation. In addition, groups of silica fragments are often found in this formation. The spread of this formation are located in the vicinity as undulating plain. Formation Buara (Ql) in the form of coral reefs are Quaternary age, including surrounding Mandonga and Abeli districts. Formation Meluhu (TRjt) consists of sandstone, shale, schist, quartzite and mudstone. This formation is the oldest rocks in the study site. The age of the Triassic to the Jurassic. These rocks are exposed only in a few places, namely around Nipa-Nipa Mountains and Abeli Hills. Sulawesi Molasa group (Tmpp) consists of sedimentary clastic formed on post-Neogene orogeny. Molasa Sulawesi that widespread in Southeast Sulawesi arm, are composed of clastic and carbonate sedimentary rocks [4].

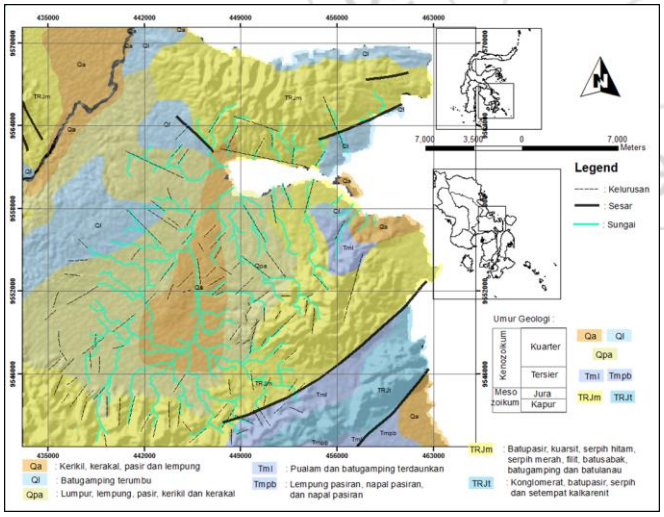

Figure 2: Geology of Kendari Basin.

Grain size analysis conducted by drying and sieving sediment samples. Siftings materials are separated by grain size (sand, silt and clay) for a specified percentage of each grain size. These results were analyzed by basic statistical methods. Working procedures of the analysis of the grain size is as follows:

1. Dry samples with the drying under direct sunlight.
2. Considering the sample weighing 1000 grams.
3. Sift the sample using the Sieve Shaker with sieve size 4, 8, 16, 30, 50, 100, 150 and 200 meshes.
4. Considering re-sampled according to the sieve mesh size sieve.
5. Splitting the sample in the sample bag is based on grain size.
6. Analyze the samples using Software Microsoft Excel 2007 to calculate the percentage of sediment grain size and sorting.

This study analyzed 20 samples taken with random sampling method along the watershed Wanggu. To facilitate the analysis, the sample was divided into three (3) zones. Zone I is the upstream of the rivers that are integrated in the watershed Wanggu, Zone II is a middle watershed Wanggu and Zone III is downstream of the watershed Wanggu (Kendari Bay area).

3. Result and Discussion

The grain size data based on 20 samples taken from the basin Kendari. They have been analyzed by the granulometry method. The result of analysis can be seen in Table 1.

Table 1: The granulometri analysis of sediment samples from Kendari basin

Sample	% cumulative							statistical				Description			
	95	84	75	50	25	16	5	Mean	Sortasi	Skewness	Kurtosis	Mean	Sortation	Skewness	Kurtosis
WG1	3,4	3,2	3,0	2,6	1,8	0,4	-1,5	0,6	0,7	-0,7	1,7	coarse	MWS	VCS	VL
WG2	2,8	2,5	2,3	1,6	0,5	-0,6	-2,4	1,2	0,8	-0,5	1,2	Moderately	MS	VCS	L
WG3	3,0	2,5	2,3	0,5	-1,8	-2,2	-2,8	0,3	1,2	-0,1	0,6	coarse	PS	CS	VP
WG4	2,8	2,6	2,4	2,0	1,5	0,8	-1,0	1,8	0,5	-0,5	1,7	Moderately	MWS	VCS	VL
WG5	2,6	2,5	2,3	1,6	-2,3	-2,6	-3,0	0,5	1,3	-0,6	0,5	coarse	PS	VCS	VP
WG6	3,0	2,4	2,0	-0,4	-1,8	-2,5	-2,8	-0,2	1,2	0,2	0,6	very coarse	PS	FS	VP
WG7	3,0	2,6	2,4	0,1	-2,6	-2,8	-3,0	0,0	1,4	-0,1	0,5	coarse	PS	CS	VP
WG8	3,3	3,2	3,0	2,5	0,8	-0,6	-1,6	1,7	1,0	-0,7	0,9	Moderately	PS	VCS	P
WG9	3,2	3,0	2,7	2,4	1,6	-1,5	-2,3	1,3	1,1	-0,7	2,0	Moderately	PS	VCS	VL
WG10	2,6	2,5	2,4	1,8	1,3	0,8	-0,8	1,7	0,4	-0,4	1,3	Moderately	WS	VCS	L
WG11	2,5	1,8	1,6	0,8	-0,4	-1,0	-2,3	0,5	0,7	-0,3	1,0	coarse	MWS	CS	M
WG12	2,8	2,3	1,7	0,8	-0,8	-2,3	-2,7	0,3	1,2	-0,3	0,9	coarse	PS	CS	M
WG13	3,2	2,9	2,7	2,3	1,8	1,5	-1,8	2,2	0,4	-0,4	2,3	fine	WS	VCS	VL
WG14	2,8	2,5	2,4	1,8	1,3	1,2	0,7	1,8	0,3	0,0	0,8	Moderately	VWS	NS	P
WG15	2,6	2,3	1,7	0,0	-1,0	-1,5	-2,3	0,3	1,0	0,1	0,7	Moderately	PS	NS	P
WG16	3,2	2,8	2,6	2,2	1,6	1,4	-0,3	2,1	0,4	-0,3	1,4	fine	WS	CS	L
WG17	3,2	2,8	2,4	1,4	-1,5	-2,6	-3,0	0,5	1,4	-0,5	0,7	coarse	PS	VCS	P
WG18	2,7	2,4	1,8	0,7	-1,4	-2,3	-2,8	0,3	1,2	-0,3	0,7	coarse	PS	CS	P
WG19	2,7	2,4	1,8	0,7	-1,4	-2,3	-2,8	0,3	1,2	-0,3	0,7	coarse	PS	CS	P
WG20	1,0	0,6	0,4	0,2	-0,3	-0,6	-1,6	0,1	0,3	-0,4	1,5	coarse	VWS	VCS	VL

Generally, that sedimentary samples from Kendari basin are moderately well sorted to poor sorted, dominant coarse skewness to very coarse skewness, and very platycurtic to very leptocurtic.

The average grain size of sediments in zone I is greater than zone II and zone III. This condition is a common condition that is controlled by the velocity gradient of the stream. In Zone I, which is upstream of the river, the current condition is relatively faster because the topography around the upstream still steep. So that the material is transported still relatively large size. As the distance increases coupled with speed reduction in river flow, sediment material is transported to the Zone II had a mean grain size smaller than the zone I (fig.3).

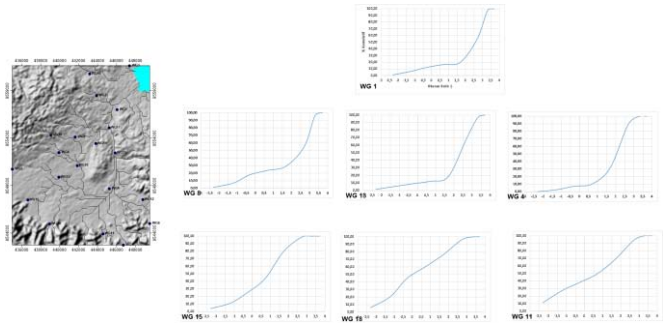

Figure 3: Sediment grain size distribution based on the mean phi on Kendari Basin Map

Based on the frequency distribution of the grain size of the sediment, generally samples of sediment from the river order 1 shows the appearance of bimodal. Only WG 11 samples that showed a unimodal peak. Bimodal frequency of sediment samples to reflect the source of sediment in the basin Kendari from diverse rock. Sediment particles in the Kendari basin is dominated sand grain size. Implications of fine sediment content is too high will cause water turbidity is low so will generally cause the water quality drops (fig.4).

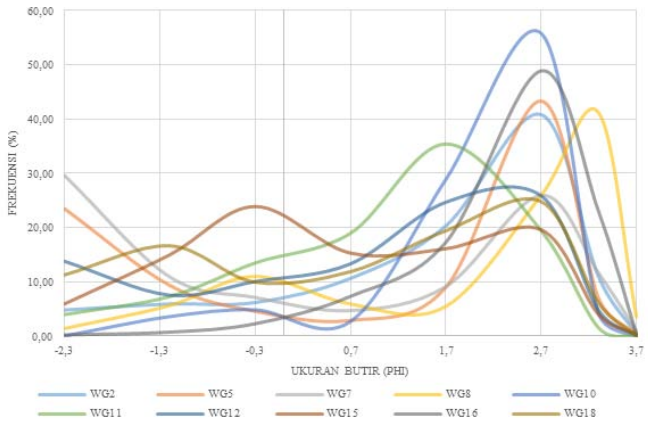

Figure 4: The graph of sediment grain size distribution based on the mean phi

Sorting value indicates a degree of uniformity of grain. The sorting value obtained from the standard deviation value. The larger the standard deviation value it will get worse sorting and vice versa. Samples of sediment in the Kendari basin is dominated by poorly sorted, only a few places like WG 1, WG 4, and WG 11 are moderately well sorted and WG 10, WG 13, and WG16 are well sorted. Samples from WG 14 and WG 20 are very well sorted. The range of standard deviation of grain size of samples between 0.3 to 1.4 interpreted depositional environment is strongly influenced by the fluvial activity.

The sediment samples have skewness ranged from -0.7 up to 0.2. Based on the statistical test obtained a dominant negative skewness (-) and only samples of WG14 and WG 15 are positive. Samples of sediment from the Kendari basin are dominated by strongly coarse. Negative skewness means more dominant coarse grained sediments. In some places, the sediment is found very coarse. Their positive and negative skewness of the sediment at the basin Kendari is a reflection of the energy fluctuations in the deposition area. Positive skewness indicates a weak transportation energy in the basin, while the area of negative skewness indicates a moderate level of energy transportation.Kurtosis measurements to determine the peak of the coarse grain size. Sediment samples from Kendari Basin is dominated by platykurtic (p) to very platykurtic (vp). Kurtosis value ranges from Kendari basin sediment samples between 0.5 to 1.4. Scatter diagram between skewness with sorting and average with sorting showed that the distribution of sand on a sample derived from river sand.

Based on multivariate statistical analysis it appears that sediment samples are strongly influenced by the activity of the river, approached the river sediment characteristics that are affected by the activity of marine (intertidal zone). It shows sediment in the basin Kendari depending on the pattern of the river contained in the basin. Changes in the pattern of the river will change the pattern of sedimentation and accumulation of eroded sediment particles results.

4. Conclusion

Studies on sedimentology used to better understand the characteristics of the sediments in the Kendari Basin. The Quaternary sediment of Kendari Basin came from a variety of rock, which is controlled strongly by fluvial activity. Based on the grain size distribution, the area upstream coarse grain size is very dominating, then the area middle stream show coarse grain size is reduced and predominantly fine grain, and last at the downstream fine-grain more dominant. Skewness shows the power flow of the carrier material erosion reduced strength and kurtosis analysis shows the influence of fluvial environment.

5. Acknowledgements

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