

## Grain-size distribution of Hlaing-pan area, Pyawbwe township, Mandalay Region

Nwe Nwe San<sup>1</sup>, Kyi Hlaing<sup>2</sup>

### Abstract

The research area is situated about 26 km northwest of Pyawbwe township in Mandalay region. This research emphasized on the grain-size distribution of Moza Formation and Khabo Formation. The Moza Formation consisted of interbedded greenish gray course-grained sandstone and laminated shales. The Khabo Formation is mainly composed of medium- to coarse-grained, brownish yellow to buff colour sandstone. In the research area, the mean size values of the Moza Formation range from 1.6  $\phi$  to 2.133  $\phi$ , while the skewness and kurtosis values are 0.05  $\phi$  to 0.33  $\phi$  and 0.50  $\phi$  to 0.55  $\phi$ . In this area, the mean size values of the Khabo Formation range from 1.733  $\phi$  to 2.5  $\phi$ , while the skewness and kurtosis values are 0.04  $\phi$  to 0.349  $\phi$  and 0.487  $\phi$  to 0.614  $\phi$  in range respectively. Thus, the sediments in the research area are positive skewness and moderately to well sorted and mesokurtic to leptokurtic. The sandstones of the research area might have deposited in shallow marine environment.

**Keywords:** sorting, skewness, kurtosis

### Introduction

The research area is located about 26 km northwest of Pyawbwe township in Mandalay Region. The research area is situated in the Central Cenozoic Belt of Myanmar. This belt is a relatively low lying province between the Eastern Highlands to the east and the Western Ranges to the west. The general regional trend of the study area is NNW-SSE direction. The research area lies in the eastern margin of northern Bago Yoma. The Bago Yoma Uplift is a prominent morphological and geological unit in Myanmar. The Bago Yoma is about 400 miles long and 40 miles wide and it is striking generally NNW-SSE between the Ayeyarwady and Sittaung valleys. The eastern part of the research area is composed of the Tertiary molassic sediments. Further to the east, the rugged terrain of the granites and other intrusive with undifferentiated metamorphic (mainly schist and gneiss of Mogok Belt) are exposed (Searle and Haq, 1964). In the west of the research area, the Pegu Group of Miocene age and Irrawaddy Formation of Late Miocene-Pliocene age are observed. Figure (1) is the location map of the study area.

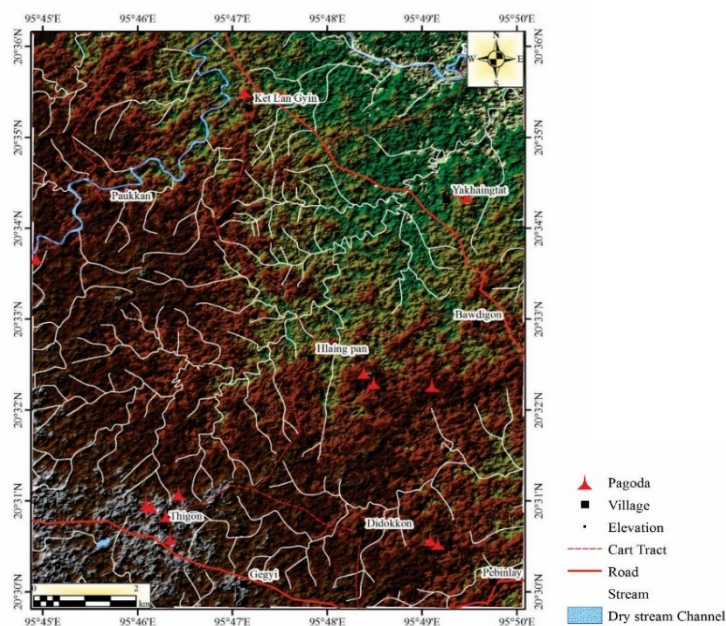


Figure-(1) Location map of the research area

<sup>1</sup> Dr., Professor, Department of Geology, Sagaing University

<sup>2</sup> Demonstrator, Department of Geology, Sagaing University

### Grain size distribution analysis

In the research area, a considerable thickness of clastic sediments is well exposed and they are observed as Upper Pegu Group. On the basis of lithological and faunal characteristics, this group of the study area can be subdivided into two units of formation rank as in descending order;

- (1) Khabo Formation (Upper Miocene)
- (2) Moza Formation (Middle Miocene)

The Moza Formation is characterized by interbedded greenish gray coarse-grained sandstone and laminated shales. The sedimentary structures of this formation are characterized by ripple mark, mud crack, cone-in-cone structure, flaser bedding, planar cross bedding and parting lineation. The Khabo Formation is mainly composed of medium- to coarse-grained, brownish yellow to buff colour sandstone. The sedimentary structures of this formation is characterized by ripple mark, mud crack, sole marking, cone-in-cone structure, planar cross bedding and trough cross bedding.

### Materials and Method

Loose and friable sandstone and sand samples were collected from different stratigraphic units. After careful disaggregation of samples, 100gm of each sample were weighted and sieved with a Ro-Tap machine for 10 minutes using USA standard sieve in the soil, the Department of Geology in Monywa University. Each fraction was weighted to nearest 0.01 gm and in most cases, sieve loss or grain is less than one percent. The resulted of the mechanical analysis were summarized in the form of histograms and cumulative frequency curves. The parameter values of medium, mean sorting, skewness and kurtosis were calculated by using the formulae of Trask (1938) and Folk & Ward (1957).

### Histograms

Histograms are simple bar diagrams showing the distribution of weight percent of the grain in each size classes. They can easily be constructed on a graph paper using the data obtained from mechanical analysis of sands. The data to be used for histograms are shown in Table (1), (4) and (Fig-2), (Fig-6). The study of the histograms indicates that the size distributions of Peguan sandstones are unimodal distribution. The weight in percent of the fine admixtures was observed to be more abundant than the coarse admixtures in the sands.

### Cummulative Frequency Curves

Cummulative frequency curves are constructed to show the percent of grains coarser or finer than any given grain size for an individual samples. They can be easily done on a semi-logarithmic paper using the data obtained from mechanical analysis of sands. These cumulative curves are shown in Figures (2), (6). The critical phi values are obtained from these curves and as shown in Table (3), (6).

### Medium and Mean Size

Medium size is the central tendency of the size distribution which is determines by the point at the crossing of the cumulative curve and the 50th percent line. The value of mean size is obtained by the formula of three points on the cumulative frequency curve ( $\phi_{16} + \phi_{50} + \phi_{84} / 3$ ) of Folk and Ward (1957). In the Moza Formation, the medium and mean ranges from 1.8 to 2.1 and 1.1 to 2.1 respectively. In the Khabo Formation, the medium and mean size range from 1.5 to 2.5 and 1.633 to 2.5 respectively.

### Sorting (Standard Deviation)

Sorting or standard deviation is a measure of spread around the mean. According to Folk and Ward (1957), measure of sorting is the Inclusive Graphic Standard Deviation ( $\sigma_1$ ). The sorting values of the Khabo Formation range from 0.547 to 0.879. According to the verbal scale of Folk and Ward (1957), these sediments are well sorted to moderately

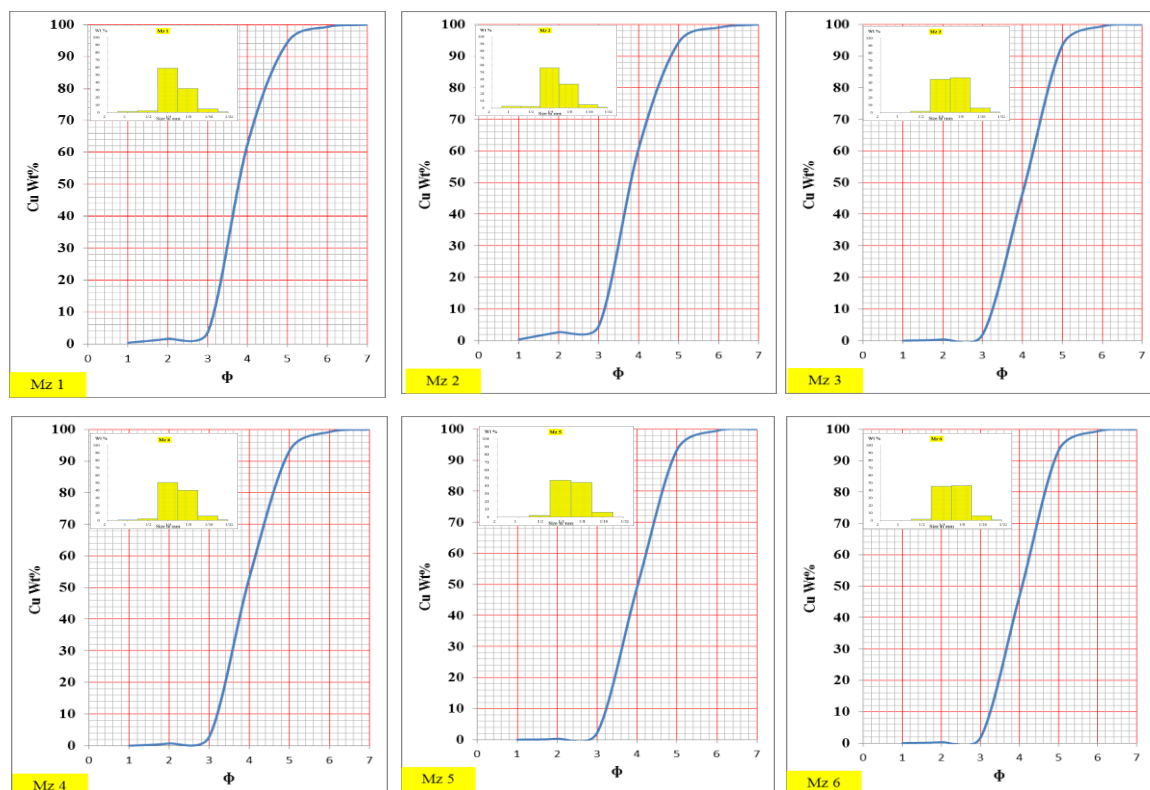


**Table (2) Grain Size Distribution Parameter Values of Moza Formation**

| Grain Size Distribution Parameter                            | Moza Formation |       |       |       |       |       |       |       |       |
|--|----------------|-------|-------|-------|-------|-------|-------|-------|-------|
|  | Mz 1           | Mz 2  | Mz 3  | Mz 4  | Mz 5  | Mz 6  | Mz 7  | Mz 8  | Mz 9  |
| Medium Diameter ( $M_d$ )                                    | 1.8            | 1.8   | 2.1   | 2.0   | 2.0   | 2.0   | 1.6   | 1.9   | 2.1   |
| Mean Diameter ( $M_z$ )                                      | 1.9            | 1.867 | 2.133 | 2.067 | 2.033 | 2.1   | 1.6   | 2.033 | 2.1   |
| Inclusive Graphite ( $\sigma_1$ ) Standard Sorting Deviation | 0.578          | 0.618 | 0.578 | 0.588 | 0.578 | 0.563 | 0.458 | 0.618 | 0.603 |
| Graphic Skewness ( $Sk_1$ )                                  | 1.105          | 0.952 | 1.050 | 0.996 | 1.005 | 1.177 | 1.088 | 1.125 | 0.925 |
| Graphic Kurtosis ( $K_1$ )                                   | 1.025          | 1.076 | 1.025 | 0.973 | 1.025 | 0.973 | 1.393 | 0.956 | 1.025 |

**Table (3) Critical Phi Values for Moza Formation**

| Sample         |      | PHI Grade |             |             |             |             |             |             |
|----------------|------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
|                |      | $\phi_5$  | $\phi_{16}$ | $\phi_{25}$ | $\phi_{50}$ | $\phi_{75}$ | $\phi_{84}$ | $\phi_{95}$ |
| Moza Formation | Mz 1 | 1.10      | 1.40        | 1.50        | 1.80        | 2.30        | 2.50        | 3.10        |
|                | Mz 2 | 1.00      | 1.30        | 1.50        | 1.80        | 2.30        | 2.50        | 3.10        |
|                | Mz 3 | 1.20      | 1.60        | 1.70        | 2.10        | 2.50        | 2.70        | 3.20        |
|                | Mz 4 | 1.20      | 1.50        | 1.70        | 2.00        | 2.50        | 2.70        | 3.10        |
|                | Mz 5 | 1.10      | 1.50        | 1.60        | 2.00        | 2.40        | 2.60        | 3.10        |
|                | Mz 6 | 1.30      | 1.60        | 1.70        | 2.00        | 2.50        | 2.70        | 3.20        |
|                | Mz 7 | 0.90      | 1.20        | 1.30        | 1.60        | 1.80        | 2.00        | 2.60        |
|                | Mz 8 | 1.20      | 1.50        | 1.60        | 1.90        | 2.50        | 2.70        | 3.30        |
|                | Mz 9 | 1.20      | 1.50        | 1.70        | 2.10        | 2.50        | 2.70        | 3.20        |



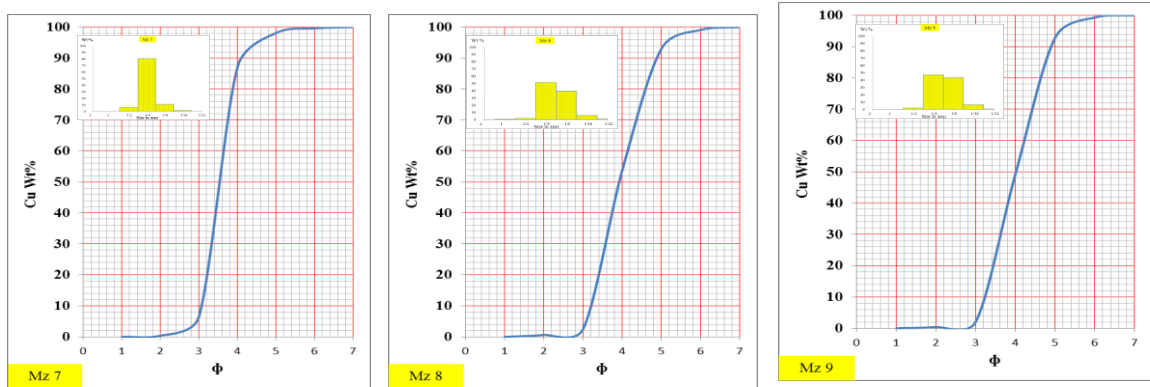


Figure (2) Histogram and cumulative curves of frequency distribution of the Moza Formation

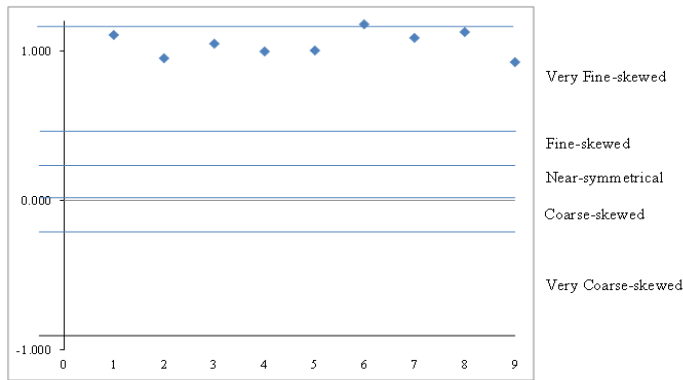


Figure (3) Sorting values of the sediments of the Moza Formation plotted in the Folk and Ward's (1957) verbal scale of sorting

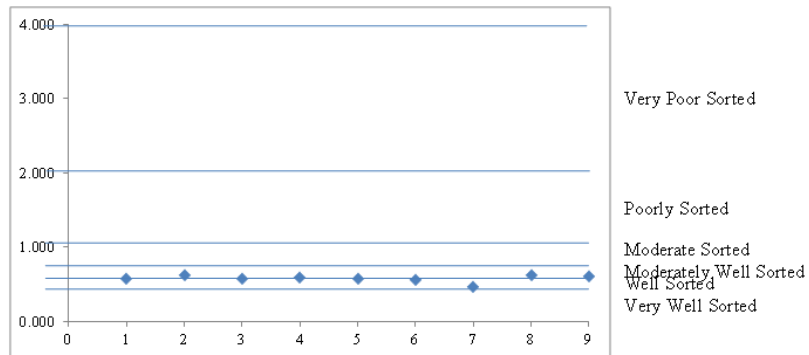


Figure (4) Skewness values of the sediments of the Moza Formation plotted in the Folk and Ward's (1957) verbal scale of skewness

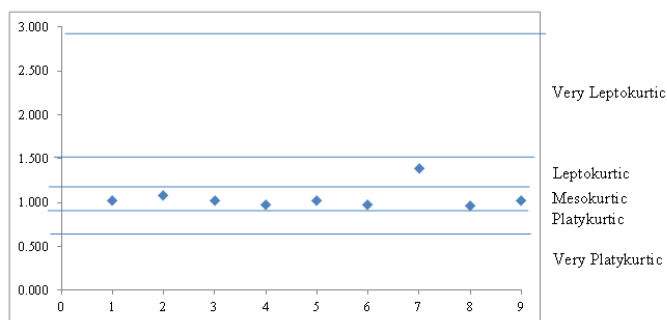


Figure (5) Kurtosis values of the sediments of the Moza Formation plotted in the Folk and Ward's (1957) verbal scale of kurtosis



**Table (5) Grain Size Distribution Parameter Values of Khabo Formation**

| Grain Size Distribution Parameter                               | Khabo Formation |       |       |       |       |       |
|---|-----------------|-------|-------|-------|-------|-------|
|   | Kb 1            | Kb 2  | Kb 3  | Kb 4  | Kb 5  | Kb 6  |
| Medium Diameter ( $M_d$ )                                       | 1.9             | 2.2   | 1.9   | 2.5   | 1.7   | 2.2   |
| Mean Diameter ( $M_z$ )   | 2.033           | 2.233 | 2.0   | 2.467 | 1.733 | 2.267 |
| Inclusive Graphite ( $\sigma_1$ )<br>Standard Sorting Deviation | 0.698           | 0.880 | 0.643 | 0.689 | 0.623 | 0.664 |
| Graphic Skewness ( $Sk_1$ )                                     | 0.930           | 0.743 | 0.965 | 0.923 | 0.883 | 1.125 |
| Graphic Kurtosis ( $K_1$ )                                      | 1.047           | 1.118 | 1.076 | 1.230 | 1.571 | 1.093 |

**Table (5) Grain Size Distribution Parameter Values of Khabo Formation**

| Grain Size Distribution Parameter                               | KhaboFormation |       |       |       |       |       |
|---|----------------|-------|-------|-------|-------|-------|
|   | Kb 7           | Kb 8  | Kb 9  | Kb 10 | Kb 11 | Kb 12 |
| Medium Diameter ( $M_d$ )                                       | 2.0            | 1.7   | 1.9   | 2.0   | 2.5   | 2.1   |
| Mean Diameter ( $M_z$ )   | 2.033          | 1.833 | 2.067 | 2.067 | 2.5   | 2.133 |
| Inclusive Graphite ( $\sigma_1$ )<br>Standard Sorting Deviation | 0.548          | 0.759 | 0.537 | 0.508 | 0.729 | 0.563 |
| Graphite Skewness ( $Sk_1$ )                                    | 1.010          | 0.917 | 0.923 | 1.188 | 0.913 | 1.097 |
| Graphite Kurtosis ( $K_1$ )                                     | 1.054          | 1.383 | 0.638 | 0.995 | 1.138 | 0.973 |

**Table (6) Critical Phi Values for Khabo Formation**

| Sample          |       | PHI Grade |             |             |             |             |             |             |
|-----------------|-------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|
|                 |       | $\phi_5$  | $\phi_{16}$ | $\phi_{25}$ | $\phi_{50}$ | $\phi_{75}$ | $\phi_{84}$ | $\phi_{95}$ |
| Khabo Formation | Kb 1  | 1.00      | 1.40        | 1.60        | 1.90        | 2.50        | 2.80        | 3.30        |
|                 | Kb 2  | 0.90      | 1.40        | 1.70        | 2.20        | 2.80        | 3.10        | 3.90        |
|                 | Kb 3  | 1.10      | 1.40        | 1.60        | 1.90        | 2.40        | 2.70        | 3.20        |
|                 | Kb 4  | 1.30      | 1.80        | 2.10        | 2.50        | 2.90        | 3.10        | 3.70        |
|                 | Kb 5  | 0.70      | 1.20        | 1.40        | 1.70        | 2.00        | 2.30        | 3.00        |
|                 | Kb 6  | 1.30      | 1.70        | 1.80        | 2.20        | 2.70        | 2.90        | 3.70        |
|                 | Kb 7  | 1.20      | 1.50        | 1.70        | 2.00        | 2.40        | 2.60        | 3.00        |
|                 | Kb 8  | 0.80      | 1.20        | 1.40        | 1.70        | 2.20        | 2.60        | 3.50        |
|                 | Kb 9  | 1.20      | 1.50        | 1.60        | 1.90        | 2.50        | 2.80        | 2.60        |
|                 | Kb 10 | 1.30      | 1.60        | 1.70        | 2.00        | 2.40        | 2.60        | 3.00        |
|                 | Kb 11 | 1.30      | 1.80        | 2.00        | 2.50        | 2.90        | 3.20        | 3.80        |
|                 | Kb 12 | 1.30      | 1.60        | 1.70        | 2.10        | 2.50        | 2.70        | 3.20        |

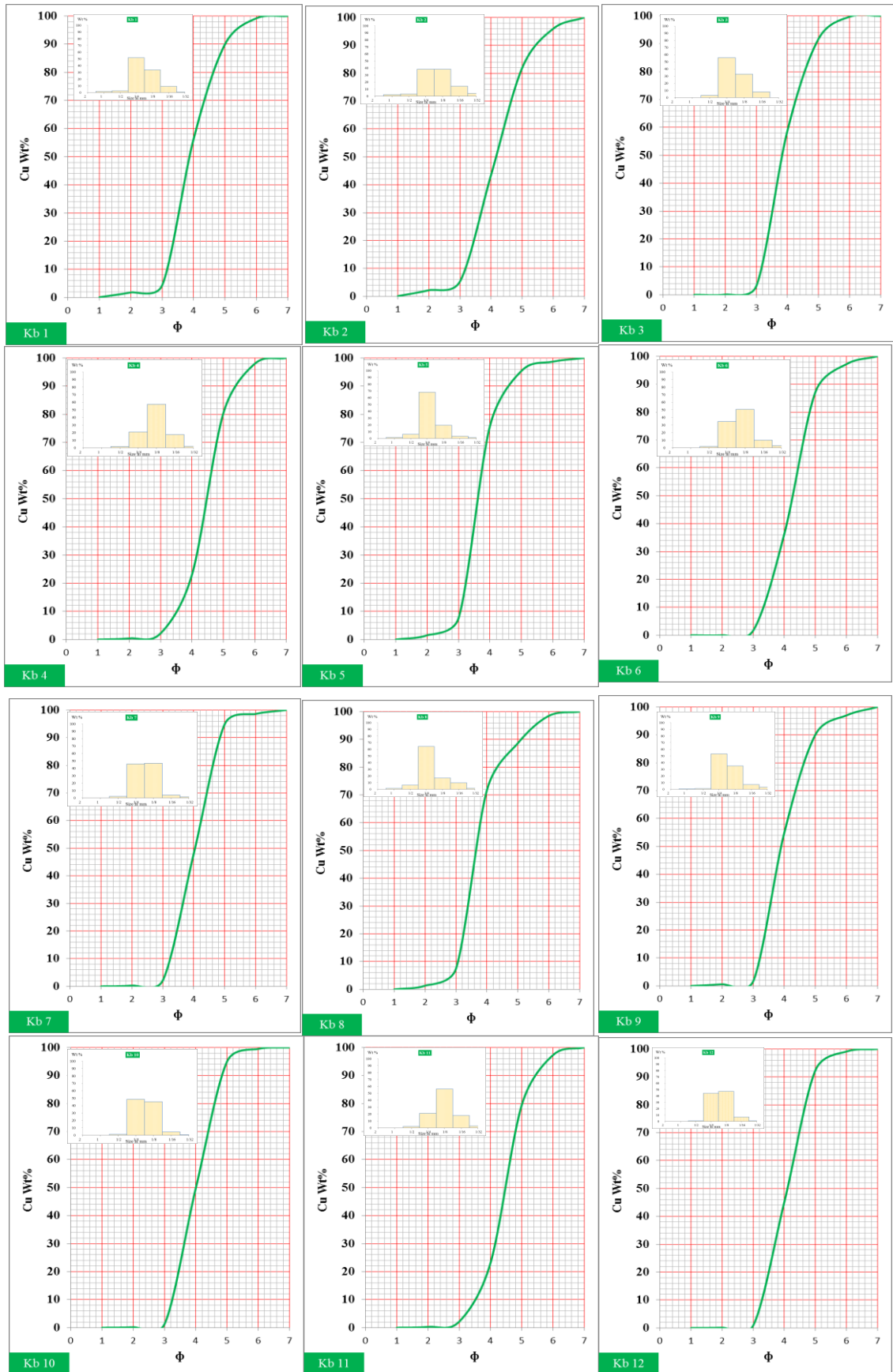


Figure (6) Histogram and cumulative curves of frequency distribution of the Khabo Formation

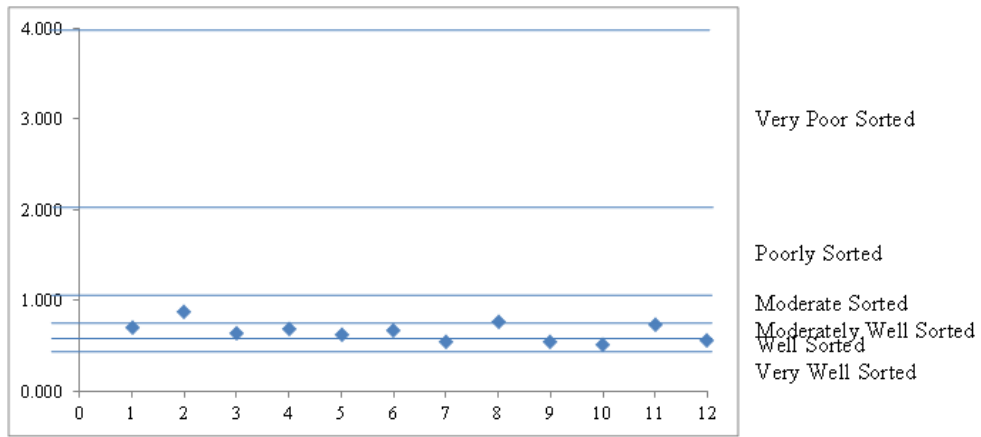


Figure (7) Sorting values of the sediments of the Khabo Formation plotted in the Folk and Ward's (1957) verbal scale of sorting.

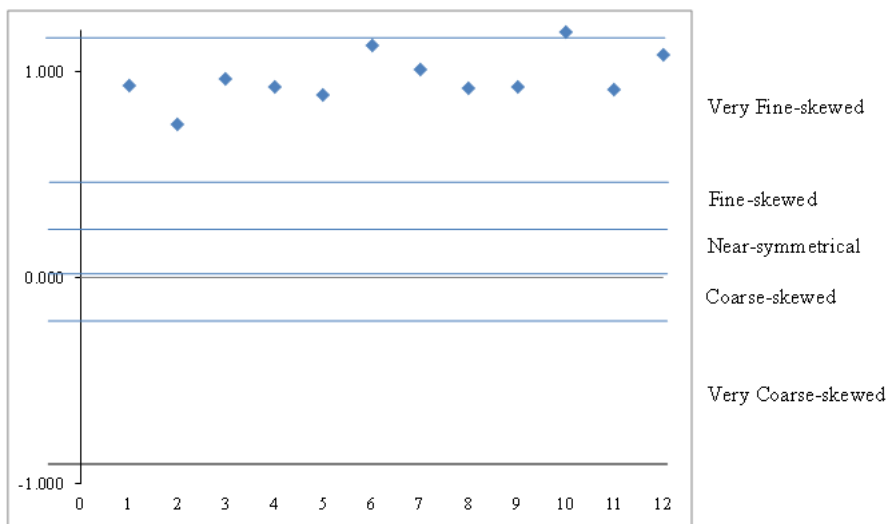


Figure (8) Skewness values of the sediments of the Khabo Formation plotted in the Folk and Ward's (1957) verbal scale of skewness.

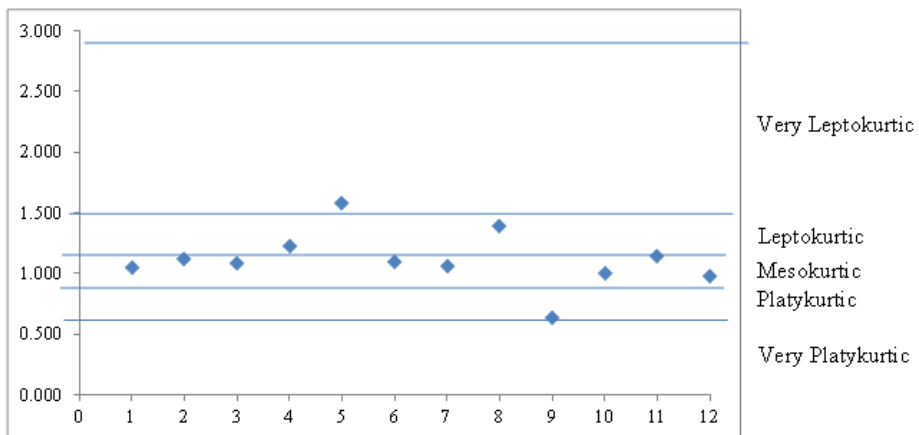


Figure (9) Kurtosis values of the sediments of the Khabo Formation plotted in the Folk and Ward's (1957) verbal scale of kurtosis.

### Summary and Conclusion

The selective actions of the transporting agents are indicated by skewness and kurtosis (Krumbein and Pettijohn, 1938). They are extremely used by Folk and Ward (1957).

According to Friedman (1961), the beach sands have mean grain-size values lower than 1.49  $\phi$  and the lower limit of mean grain-size of the dune sand is 1.49  $\phi$ . The mean size values of the Moza Formation range from 1.6 $\phi$  to 2.133  $\phi$ , while the skewness and kurtosis values are 0.05  $\phi$  to 0.33 $\phi$  and 0.50  $\phi$  to 0.55 $\phi$  in the study area. In the study area, the mean size values of the Khabo Formation range from 1.733 $\phi$  to 2.5 $\phi$ , while the skewness and kurtosis values of this Formation are 0.04  $\phi$  to 0.349  $\phi$  and 0.487 $\phi$  to 0.614 $\phi$  in range respectively. Such type of mean size and skewness value are dune sands field separation of mean grain-size, plotted against skewness for dune and beach sands by Friedman (1961). Moreover, the types of kurtosis and skewness are generally failed among the most river sands with exception of each sand described by Friedman (1961) for beach and river sand of skewness, plotted against kurtosis.

The standard deviation values of sediments in the research area are 0.457 $\phi$  to 0.879 $\phi$  in range. According to Friedman (1961), the most coastal, barrier bar, and lake dune sands have a standard deviation of less 0.40 $\phi$  and the most river sands have a standard deviation in excess of 0.5 $\phi$ . According to Folk and Ward (1957), the sediments of the research area are moderately sorted, positively skewed and mesokurtic to leptokurtic. This nature of textural parameters indicates that the detrital and particles were probably derived from a proximal source area. Moreover, the sediments in the research area are positive skewness and moderately to well sorted and platykurtic to leptokurtic. The sandstone of the research area might have been deposited in shallow marine environment.

### Acknowledgements

We are deeply thankful to Dr. Soe Myint Aye, Rector of Sagaing University, Dr. Phyu Phyu Myint, Pro-rector of Sagaing University, Dr. Htay Htay Thein, Pro-rector of Sagaing University and Dr. Pyi Soe Thein, Professor and Head of the Department of Geology, Sagaing University for their kind permission to carry out this research work.

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