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# SEDIMENTATION PROCESSES IN LAKE NUBIA

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## ABSTRACT

The present work deals with the sedimentation in Lake Nubia and study of grain size composition of the lake sediments.

The decrease of the amount of the suspended matter content can be explained easily by the decrease of the speed of the current and consequently the process of sedimentation.

The majority of examined sediments are very coarse silt to very fine silt, poorly sorted to very poorly sorted, strongly fine skewed to strongly coarse skewed and platy to leptokurtic.

From the bottom level it is clear that a new delta has been formed in the area south wadi Halfa.

## INTRODUCTION

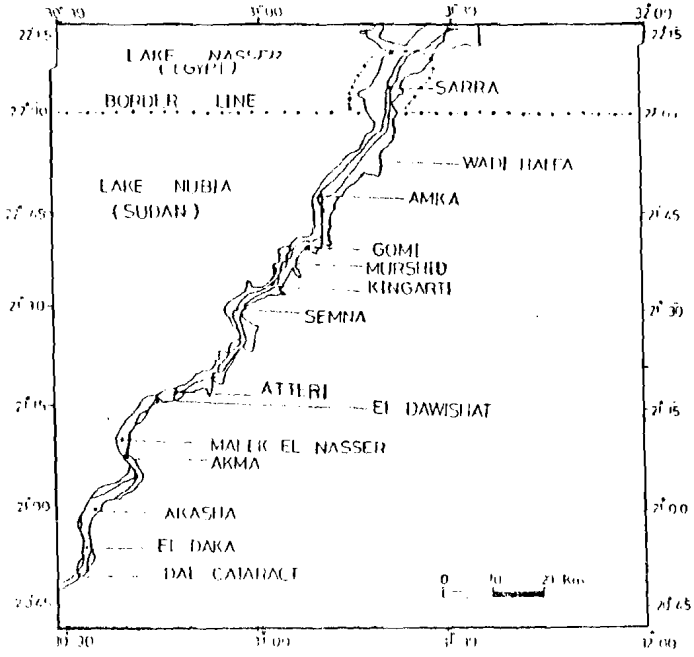
Lake Nubia was created on the River Nile by the High Dam, lying south Lake Nasser. It lies between latitudes 20° 45 N and 22° 15 N and longitudes 30° 30 E and 31° 30 E longitude (Fig. 1).

The volume of the Lake at 160 m above sea level is about 10.10 $Km^3$ and at 180 m level it would be 26.94 $Km^3$. The covered area is about 522 $Km^2$ and 1039 $Km^2$ at 160 and 180 m levels, respectively (Entz, 1974).

Undoubtly, because of the sedimentation in the Lake, many of the channel islands and hills have been buried. Sand dunes which were accumulated by the action of wind are encountered in the Lake region (El-Dardir, 1984).

Some studies of the sediments and water of the Lake Nubia are given by (Entz, 1974; Sherif et al., 1978; Latif, 1982 and Dahab, 1983).

The present work aims to illusterate the sedimentation in Lake Nubia and to study the composition of grain size in the reservoir sediments.




## MATERIAL AND METHODS

A- Sampling :

Twenty three representative samples from the lake sediments were collected at 9 profiles from 23 sites (as shown in Fig. 1) using a Peterson grab sampler.

B- Grain size analysis :

In the present work two techniques were used for the determination of the particles size distribution of the samples. These are sieving and settling velocity techniques.

C- Velocity of current :

The velocity of current was measured by means of current meter type Cm 25.

D- Suspended matter content :

The suspended material was measured after drying one liter of water at 102°C.

## RESULTS AND DISCUSSION

SEDIMENTATION :

After the construction of the Aswan High Dam, the amount of the Nile sediments have been held in the Aswan High Dam reservoir.

According to Hurst (1927), the amount of sediment transported annually by the Nile at Wasi Halfa was $10^8$ tonnes ( 0.04 $Km^3$ per year).

Entz (1974) and Abul-Haggag (1977) mentioned that the Nile flood usually carries a high load of sediments estimated as 125 x $10^6$ $m^3$ annually.

The amount of suspended matter is rather small, when the flood starts. But there after within few days the sediment reaches its maximum. Afterwards it decreases again as rapidly as it increased.

The concentration of suspended material decreased northwards from El-Daka near Dal Cataract lying at the beginning of the Lake (6.028 g/l) to Wadi Halfa (0.147 g/l). The amount of this suspended matter is high as compared with the values could be measured during June in 1981 and in 1982 and ranged between 8-37 mg/l and 6-51 mg/l, respectively (El-Dardir, 1984).

The velocity decreases from 195.5 cm/sec at Kingarti to 91.3 cm/sec at Atteri to 8.9 cm/sec at Wadi Halfa (Table 1). Generally, the speed current of water goes parallel with the suspended matter as it decreases northwords (Table 1 & Fig. 2) except at Kingarti and Gami, where this part is characterized by an abrupt increase in the current speed. This, due to that the Lake is narrower at the south in this area. Table 2 illustrates the amount of sediment concentrations within the Gorge region of Lake Nubia from 1973-1985. The grand total of the whole sediment deposited in the Lake was estimated as (1713.555 x $10^6$ $m^3$).

The geographical distribution of sedimentation in the Aswan High Dam reservoir depends on the volume of the flood water and level of water in the reservoir at the flood period (Scott et al., 1978).

Figures 3 and 4 are showing the thickness of the sediments at some sections across Lake Nubia based on echosounding profile (according to measures of Aswan High Dam Authority) and from the bottom level (Fig. 5). It is clear that a new under water delta has been formed south Wadi Halfa.

Entz (1974) concluded that the values of electrical conductance give an indication on the rate of sedimentation. Thus, the mud samples collected from the south most part of Lake Nubia showed identical values (450-600 µmhos). However, within the area of the main sedimentation south Wadi Halfa, higher values could be detected and recorded (750-1120 µmhos) in the gorge regions.

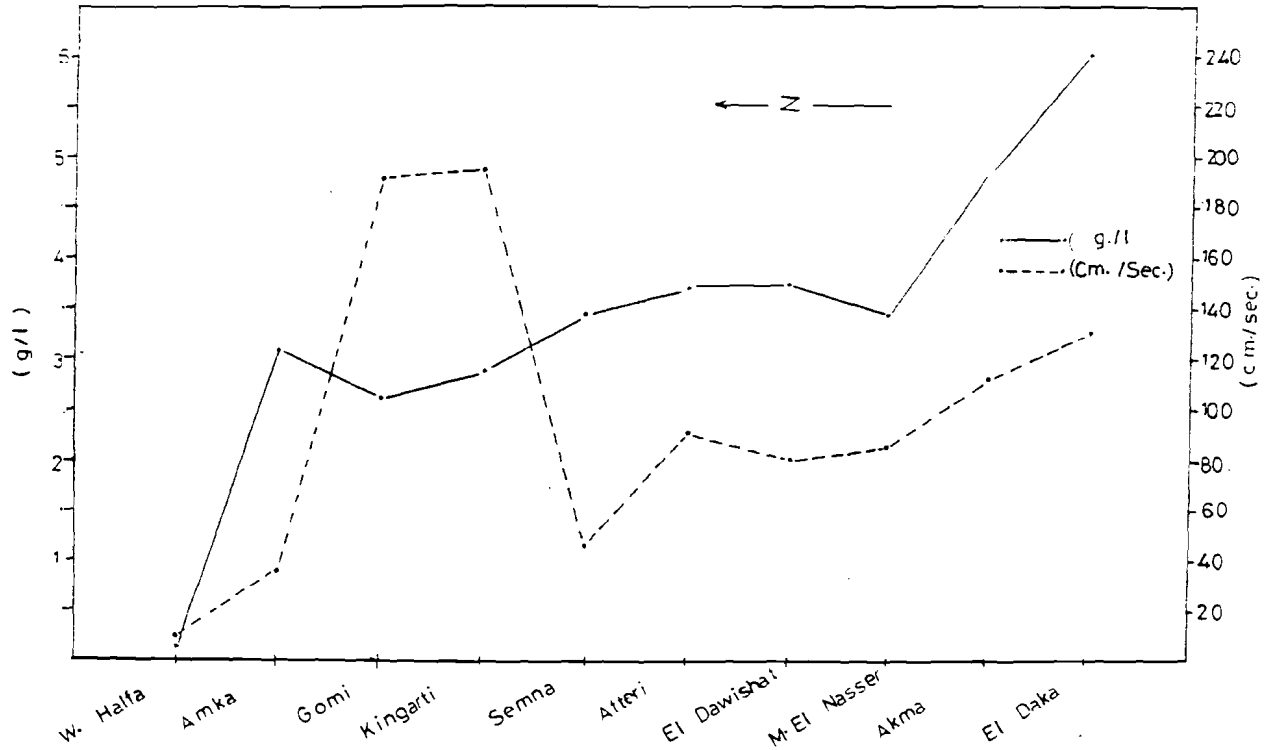



Fig. (2)
Suspended matter (g/l) of Lake Nubia v.s. speed velocity (cm / sec), during July 1985.

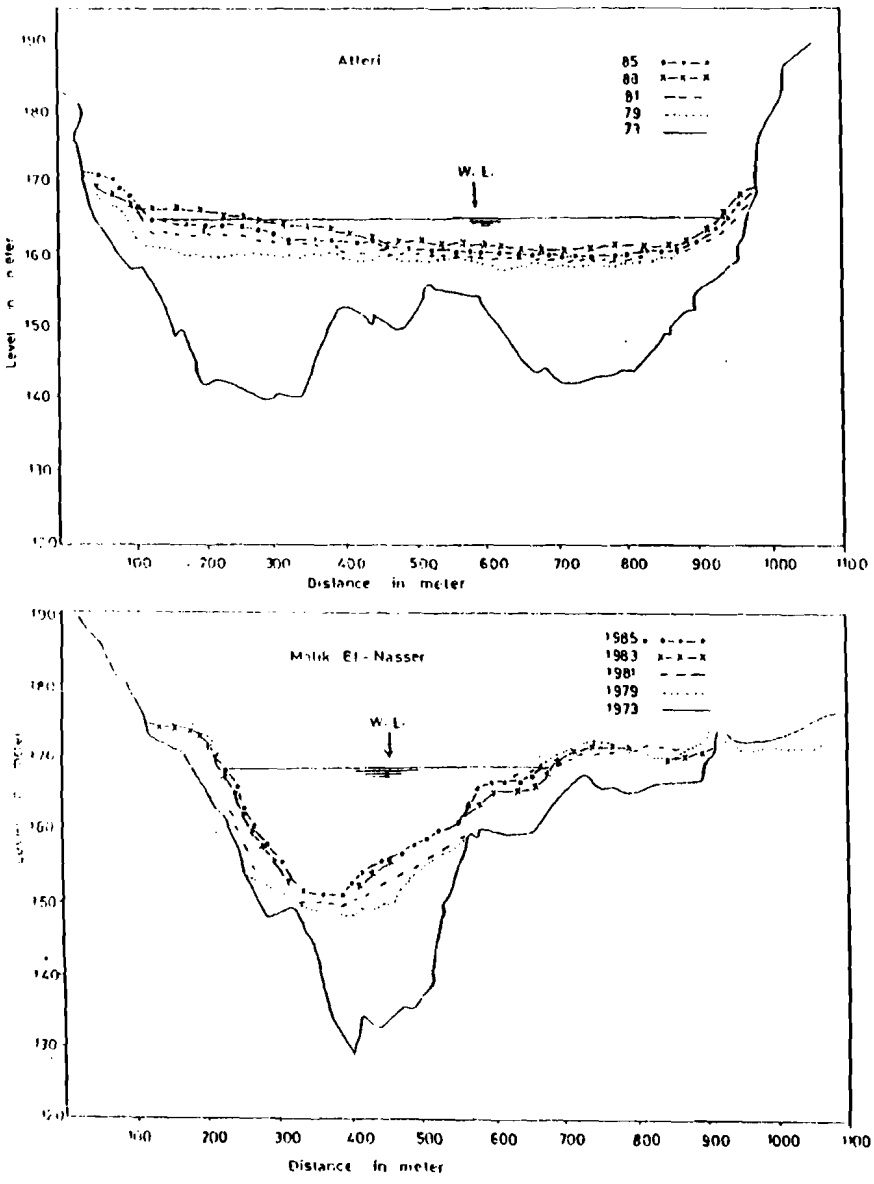
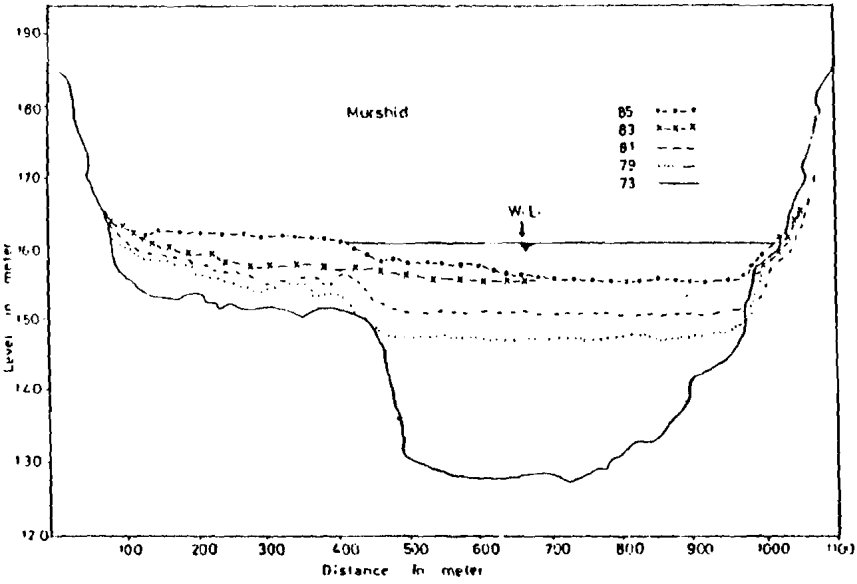



Fig. (3)
Sections across Lake Nubia at Malik El-Nasser and Atteri.



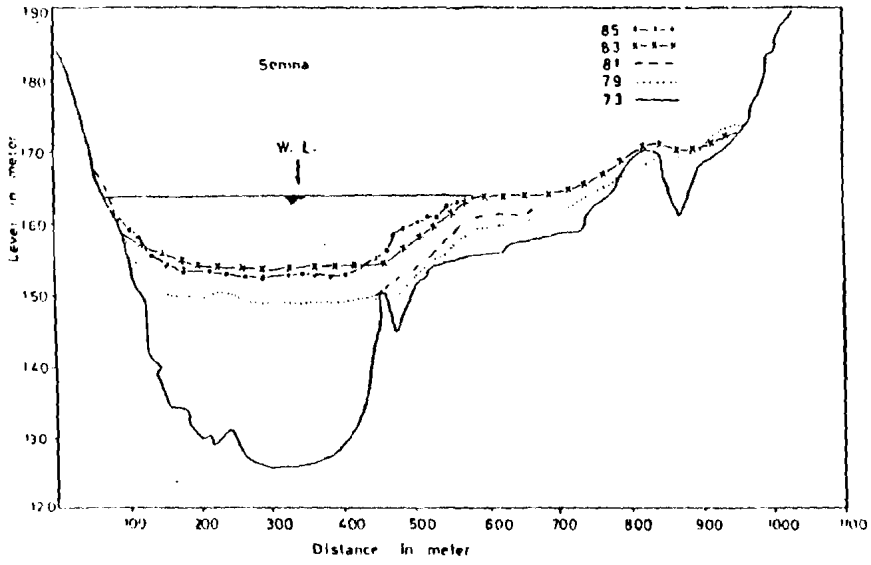




Fig. (4)
Sections across Lake Nubia at Semna and Murshid.

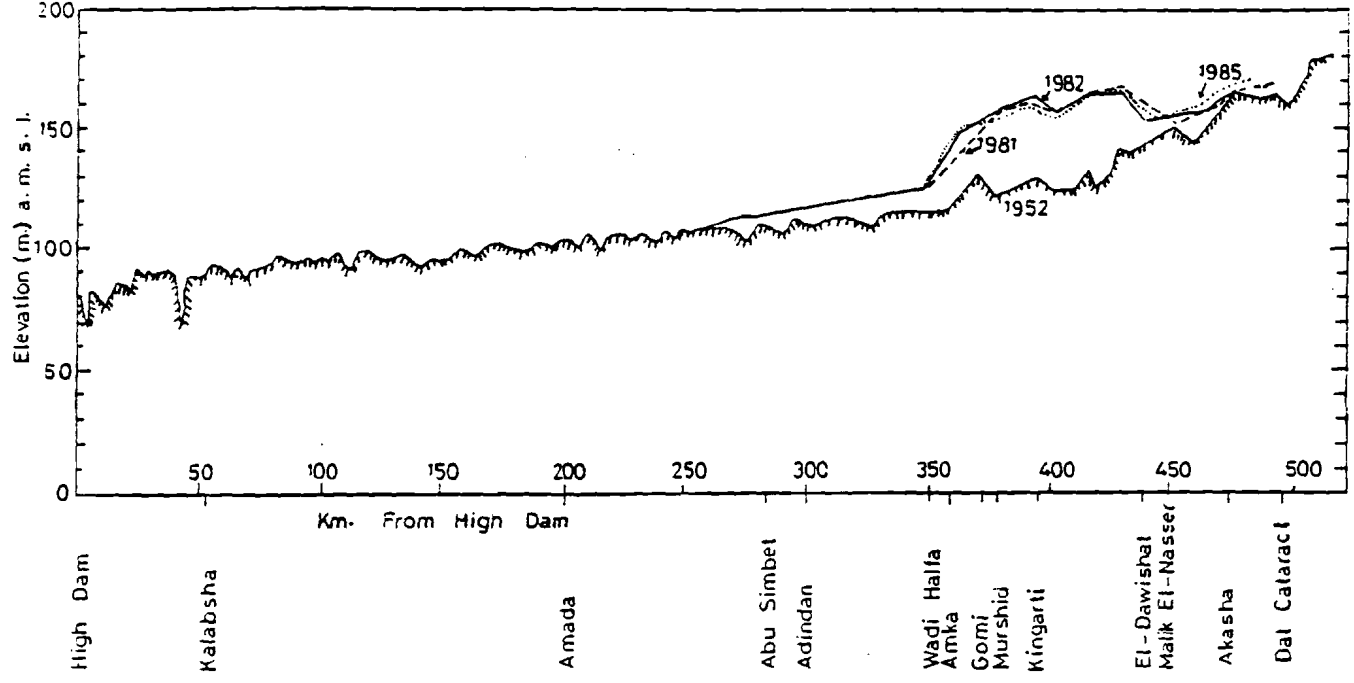



Fig. (5)
Average base levels of the reservoir during 1952, 1981, 1982 and 1985.

Table (1)
Average water velocity (cm/sec) and suspended matter (mg/l) in some localities of Lake Nubia during July 1985.

| Locality | W. V. (cm./sec) | S.M. (g/l) | Km./M.D |
|---|---|---|---|
| El-Daka | 130.0 | 6.028 | 487 |
| Akma | 113.1 | 4.858 | 466 |
| M. El-Nasser | 85.5 | 3.470 | 448 |
| El Dawishat | 80.3 | 3.784 | 431 |
| Atteri | 91.3 | 3.716 | 415 |
| Semna | 44.9 | 3.463 | 403 |
| Kingarti | 195.5 | 2.898 | 394 |
| Gomi | 191.1 | 2.613 | 372 |
| Amka | 335.7 | 3.106 | 565 |
| Wadi Halfa | 8.9 | 0.147 | 347 |

Table (2)
Amount of deposited sediment (million $m^3$) in Lake Nubia during the period (1973-1985).
( After the High Dam Authority, Personal Communication).

| Period | Amount of Sediment ( million $m^3$ ) |
|---|---|
| 1973 | 356.823 |
| 1973 - 1979 | 713.755 |
| 1979 -1982 | 201.726 |
| 1982 - 1983 | 118.063 |
| 1983 - 1985 | 323.188 |
| Total | 1713.555 |

## GRAIN SIZE DISTRIBUTION

The granulometric analysis is used to obtain numerical and graphical data concerning the particle size distribution in Lake Nubia sediments. Cumulative curves were constructed using probability paper in the same manner to that used by Folk (1961). The grain size parameters (Table 3) calculated according to Folk and Ward (1957).

**Relation Between Grain Size Parameters:**

Different authors used the relationships between grain size parameters for the differentation various environments of deposition for example, (Mason and Folk, 1958; Friedman, 1961; Moiola and Weiser, 1968). These relationships are illusterated in (Fig. 6) for the studied samples.

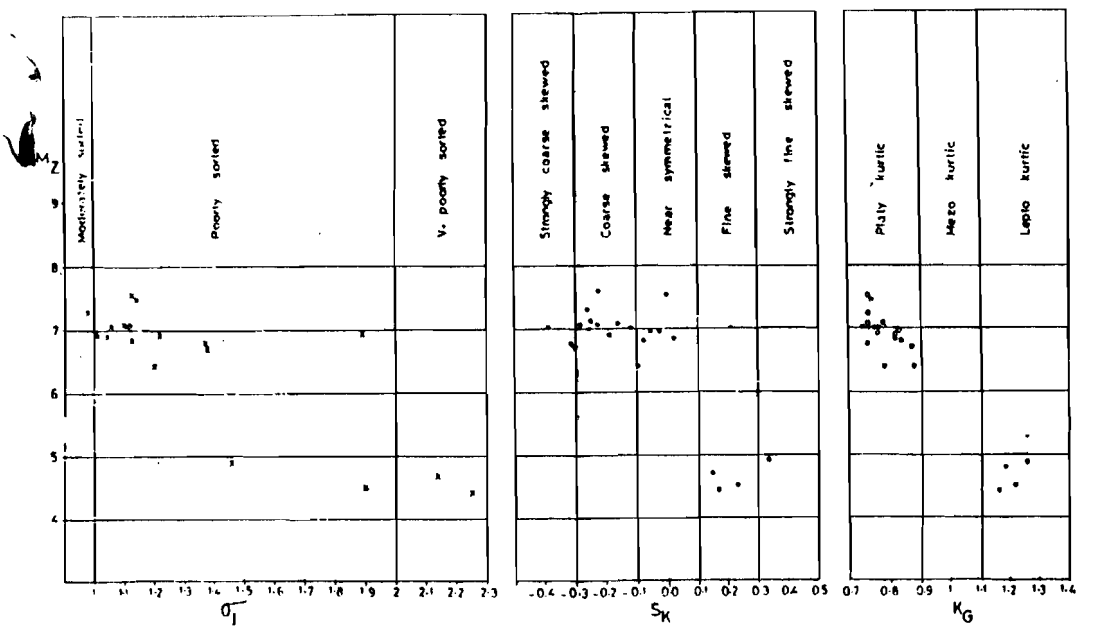



Fig. (6)
Relation between mean size ( $M_z$ ), graphic standard deviation ( $\sigma_I$ ), graphic skewness ( $S_k$ ) and graphic kurtosis ( $K_G$ ).

Table (3)

Grain size parameters

| Sample No. | $M_z$ | | $S_k$ | $K_G$ | Location | Station | Km. / H.D |
|---|---|---|---|---|---|---|---|
| 1 | 4.50 | 1.90 | 0.23 | 1.22 | Dal Cataract | middle | 495 |
| 2 | 6.90 | 1.89 | 0.19 | 0.82 | El Daka | east | 487 |
| 3 | 6.43 | 1.21 | -0.1- | 0.78 | " | west | 487 |
| 4 | 4.91 | 2.46 | 0.34 | 1.26 | Akasha | east | 480 |
| 5 | 4.70 | 2.13 | 0.15 | 1.19 | " | middle | 480 |
| 6 | 4.40 | 2.26 | 0.17 | 1.17 | " | west | 480 |
| 7 | 7.00 | 1.02 | -0.12 | 0.75 | M. El Nasser | east | 448 |
| 8 | 6.83 | 1.12 | -0.08 | 0.84 | " | west | 448 |
| 9 | 6.98 | 1.00 | -0.03 | 0.76 | El Dawishat | east | 431 |
| 10 | 7.13 | 0.99 | -0.16 | 0.73 | " | middle | 431 |
| 11 | 6.95 | 1.02 | -0.07 | 0.87 | " | west | 431 |
| 12 | 6.88 | 1.04 | 0.02 | 0.82 | Atteri | east | 415 |
| 13 | 7.06 | 1.10 | -0.23 | 0.78 | " | middle | 415 |
| 14 | 7.56 | 1.12 | -0.22 | 0.73 | " | west | 415 |
| 15 | 7.05 | 1.10 | -1.10 | 0.77 | Semna | east | 403 |
| 16 | 7.11 | 1.13 | -0.38 | 0.78 | " | middle | 403 |
| 17 | 6.70 | 1.38 | -0.30 | 0.87 | " | west | 403 |
| 18 | 7.08 | 1.05 | -0.25 | 0.73 | Murshid | east | 378 |
| 19 | 7.08 | 1.10 | -0.25 | 0.71 | " | middle | 378 |
| 20 | 7.48 | 1.13 | 0.0 | 0.74 | " | west | 378 |
| 21 | 6.75 | 1.37 | -0.31 | 0.73 | Sarra | east | 323 |
| 22 | 7.28 | 0.98 | -0.26 | 0.73 | " | middle | 323 |
| 23 | 6.90 | 1.22 | 0.26 | 0.88 | " | west | 323 |

1. Mean Size "$M_Z$" Versus Graphic Standard Deviation "$\sigma_1$" :

The scatter diagram of mean size "$M_Z$" versus graphic standard deviation shows that there is general tendency for sorting to improve with the increase of the graphic mean size values. The analysed samples have "$M_Z$" values between 4.40 and 7.56 favoring very coarse silt to very fine silt with very poorly and moderately sorted.

2. Mean size "$M_Z$" versus Skewness "$SK_I$" :

Fig. (6) shows that the samples which have "$M_Z$" values mainly ranging between 6.4 0 and 7.56 0 (medium silt to very fine silt) are near symmetrical skewed to strongly coarse skewed ( -0.4 to 0.02).

3. Mean size "$M_Z$" versus kurtosis "$K_G$" :

The scatter diagram of "$M_Z$" versus kurtosis "$K_G$" (Fig. 6) indicated that the most analysed samples clustered in the area between 0.7 and 0.9 (platy kurtic).

## CONCLUSIONS

In the Lake Nibua the highest load value of suspended matter prevailed in the southern part and lowest value in the northern region and this goes parallel with current speed except at kingarti and Gomi, where this part is characterized by an abrupt increase in the velocity.

From the grain size analysis the following characteristics are given:

a) The mean size of the sediment samples varies between 4.40 0 and 7.56 0 (very coarse silt to very fine silt).

b) The graphic standard deviation ranges between 0.98 and 2.46 (moderately sorted to very poorly sorted).

c) The skewness ranges between -0.38 to 0.34 (strongly coarse - skewed and fine-skewed).

d) Kurtosis of the samples varies between 0.71 - 1.26 (Platy Kurtic and Lepto Kurtic).

The formation of the new delta can be expected near Wadi Halfa.

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