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Study on River Terraces in Upper and Middle Parts of Kabul Sedimentary Basin, Afghanistan

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Abstract: ***This research cariedout study of heavy and light minerals in Kabul, Loger and Paghman rivers terraces, which is located in upper and middle parts of Kabul basin in Afghanistan. The younger sediments of upper and middle parts of Kabul have different size and thickness, in upper part of Kabul is morethan consolidated Gravels, belonging to Quaternary but the middle basin of Kabul is consist of sandston, gray, white green and brown Marble. This research is therefore essential to estimate the different size of river sediments, with no or scarce previous researchs in this basin. This paper provides the results of transported at different size and type of sediments carried by rivers discharge from snow covered areas of upper and middle parts of Kabul basin in Afghanistan. The main objective of this study is to selected different size and type of river sediments transported by Kabul, Loger and Paghman rivers discharges in upper and middle parts of Kabul basin for the previous geological periods. From analysis, in middle terrace of Paghman river, Granaite 87 %, Quarsite 9 % and Gnaize 4 %, bigger size is 8 ×10 cm and smaller is 7× 7 mm. in lower terrace of this river, Granite 77 %, Quarsite 22 % and Gnaize 1 %, bigger size is 9× 9 cm and smaller is 6× 7 mm, in upper terrace of Maranjan hill, metamorphic rocks (pholith) 84 %, Quarsite 13 % and Grainte 3 %, bigger size is 7× 8 cm and smaller is 6.6× 7 mm, in the middle terrace of Nawruzabad hill, Pegmatite 1 %, Sederite 10 %, Quarsite 36 % and Gniaze 53 % , the bigger size is 7× 10 cm and smaller size is 6.5× 7 mm, in the upper terrace of Polycharkhy hill, Limestone 2 %, Green schist 5 %, Gnaize 93 % , bigger size is 9× 10 cm and smaller is 6.5 × 6.8 mm, respectively.***

Keywords: River Sediments, Upper and Middle parts of Kabul basin, Gravel analysis, Seving analysis, Heavy and Light minerals

1. Introduction

The basin is bounded by mountain ranges, the highest range, reaching 4,522 m in altitude, is the Paghman Mountains to the west of the study area. The Kohe Safi range to the east of the study area is as high as 3,000 m, and most of the range slopes out of the study area to the east[6]. The inter basin ridges generally rise about 200 to 500 m above the adjacent valley floors. Altitudes of the central plains range from around 1,800 m in the Central Kabul and Logar subbasins to 2,200 m in the Paghman and Upper Kabul subbasin [23]. The terraces provide good constraints on incision rates across the Himalayan frontal folds, where rivers are forced to cut down into rising anticlines and have abandoned numerous strath terraces. Farther north and upstream, in the Lesser Himalaya[12], prominent fill terraces were deposited, probably during the late Pleistocene, and were subsequently incised [10]. The morphology of the range reflects a dynamic equilibrium between present day tectonics and surface processes[15]. The sharp relief together with the high uplift rates in the higher Himalaya reflects thrusting over the midcrustal ramp rather than the isostatic response to reincision of the Tibetan Plateau driven by late Cenozoic climate change, or late Miocene reactivation of the Main Central Thrust. The kinematics of mountain building results from the combination of crustal deformation and erosion, with the two processes being possibly coupled [9]. One of the aims of this research project is mapping of some terraces of Kabul basins, determination of location heavy and light minerals[13]. For this, each sample from these terraces was taken to laboratory for analysis and find out the heavy and light minerals.Almost all basins in Afghanistan are belonging to the Tertiary geological period (Ioncene and Oligocene). They are surrounded by mountains about (20 - 45) million years ago and its sediments is by named Terciary formation and the upper and lower part of Kabul basins also belonging to this period[1]. Upper part of these sediments covered by terraces and it come gradually at lower Quaternary (Plesetocen). Quality of these sediments is related to surrounding mountains. The Kabul Basin is part of the tectonically active Kabul block in the transpressional plate boundary region of Afghanistan [23]. Afghanistan lies along the great tectonic upheaval that has produced the world's highest mountain ranges, the Himalaya, Karakoram, Pamirs, and the Hindu Kush. In the Kabul area, orogeny has been accompanied by a complex sequence of faulting. Deep crystalline grabens formed and have filled with hundreds of meters of alluvial, colluvial, and lacustrine deposits [4]. Most sediments of Neogen covered by middle Quaternary and now upper parts of these sediments covered by alluvials of upper Quaternary. Lower part of these regions are located at the deeper area of Tangi Mahypar (800 m a.s.l) and highest part of these regions located at the Paghman mountain range (up from 4522 m a.s.l). The rivers valleys are like V and U shape. Generaly Kabul basin is[17], consisting of sedimentary materials and its thickness are different from region to regions. Bagramy hill, Maranjan hill, Bibi Mahrow hill and Kalola Pushta hill are located in catchment, which are related with Terciary geological period, and these are the reminents of different Kabul basin sediments [18].

2. Study Area

This study is carried out in the three different terraces (upper, middele and lower) of Kabul, Logger and Paghman rivers (Figure,1). which is located at the upper and middle on Hindu Kush Mountain range in Afghanistan. Kabur River is starts from 80Km west side of Kabul, at elevation of 4522 m a.s.l in Paghman mountain range (Sanglakh mountains regions) belong to Hindu Kush Mountains range in Afghanistan **[21]**. The river at the first stage flows with very high velocity carrying much sediment from west to east and passes from the upper part of Maidan Share, Wardak

province**[3]**. After covering several kilometers, it changes the direction to southwest from Koha Korugh and then it is named Kabul River. It then flows from the southwest of Lalander and enters to Kabul city. Paghman river starts from (3500 m a.s.l.) Paghman mountain range, in the first stage this river running in very steep level and with very high velocity from north south to Kampany Bridge and after this river change the direction to Northwest to Northeast and in Gazarga region and join Kabul River at Chahar Dahai **[5]**. Loger river is started from (4600 m a.s.l) Daimirdad mountain (Hundu Kush mountain range) belong to Wardak province**[20]**. At the first stage this river flow from west to east, and pass from Chack and Saidabad, Wardak districts and then enter in Loger province and in Barakibarak Loger district where it join with Charkh River. After that, it enters to Kabul province and join with Kabul River at the Sheena village belong to Bagramy district **[14]**.

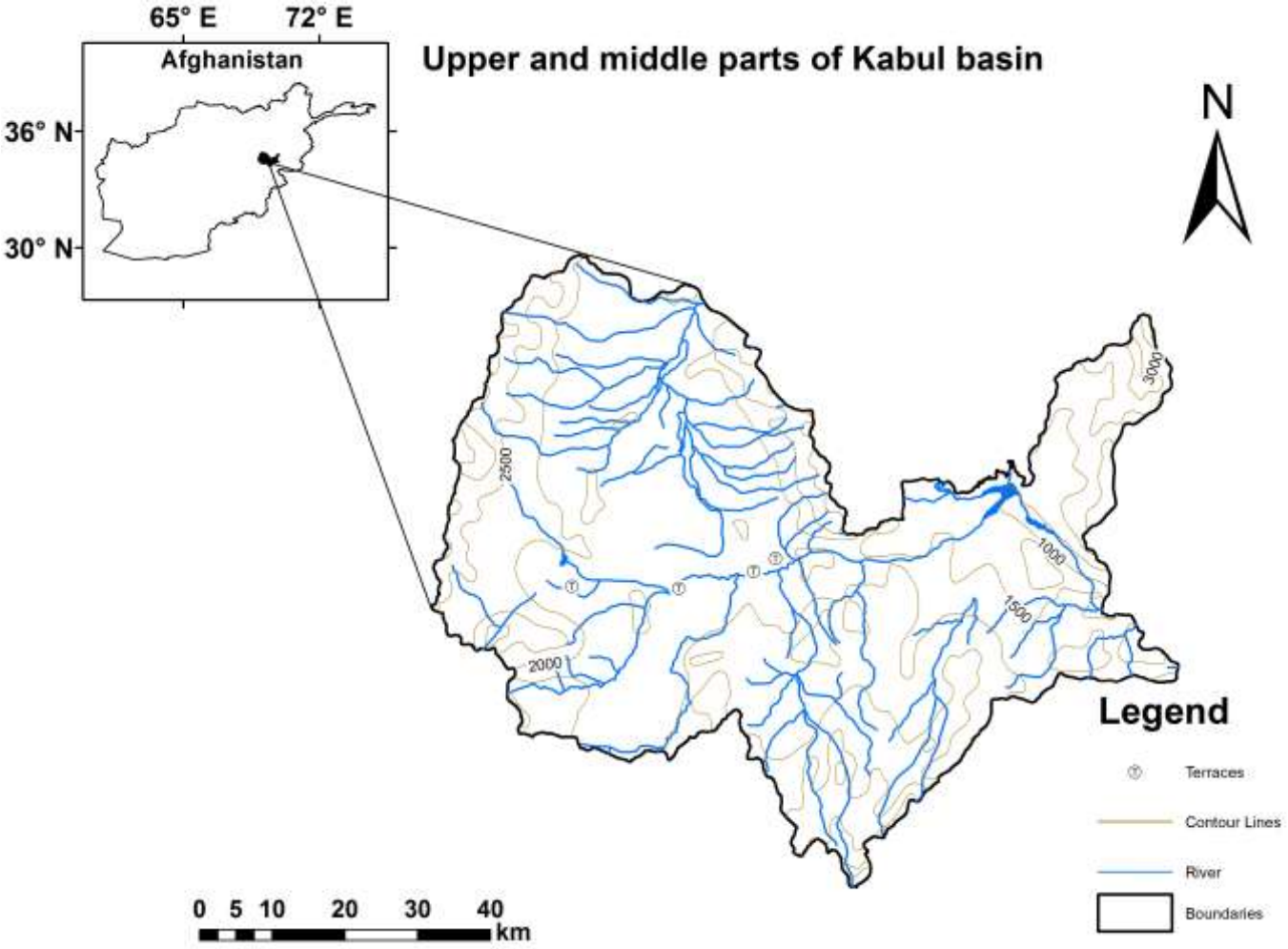

Figure 1: Location map of the Upper and middle parts of Kabul basin

3. Method and Materials

We got from every one terracese, 1 Kg sample and analysis in laboratory , geology department of Kabul university and found different siz of materials for exampal from cobble (30 × 50 cm), also very small siz (silt) and analysis by seving method , pass from 6.3 mm and from analysis bigger size (Pebbl, Granul, sand, silt) found different kind of rocks ,by seving method to determime differerent size (6.3 mm, 2 mm, 1 mm, 500 µm, 250 µm, 125 µm, 6.3 µm and Rest), also for saperating fractioctions of heavy and light minerals used 6.2 mµ and 150 mµ and mixed with one anothers amount of 300 mgr, put in the chemical solution of Bromoform (2.8 gr/cm^3), for 24 hours to separate heavy and light minerals after we dried at the 30 ^{0}C, and made Thin section for determination minerals and used polyresasion microscoph and achived different heavy and light minerals as shown in tabales 1 and 2.

4. Results

Upper and middle parts of Kabul basin is belong to Quaternary (Plastocene), [18]. Sediments carried from Paghman, Aliabad, Asmayie, Qurugh and Loger mountains. These mountains located at the surrounded area of upper and middle parts of Kabul basin and these sediments carried by water at the different periods of time and made differen thickness, the upper and middle parts of Kabul basin terracese and there accumulated some heavy and light minerals and these minerals belong to mother rocks that located at the surrounding mountains areas of Kabul basin. For example Epidote, Kyanite and Garnite we can find in some terracese of Kabul river basin because these are belong to all Metam orphic rocks (Crystalline) [8], its located at the surrounding mountains of Kabul basin, also there is some others minerals like Rutile and Zercone because its belong to Igneouse rocks of Paghman Mountains range. Inadation there is some others minerals licke Muscuvite and Biotite,

also blong to all metamorphic rocks its locted at the surrounding mountains of Kabul basin, as well as Biotite and Rutiles minerals in middle and lower terracese of Paghman river belong to Igneous Rocks of Paghman mountain range and all sediments carried by water and all to gethers accumulated in terracese[19]. All rivers of Kabul basin joined to gathers at the different locations and all running about from west to East, and sediments of this basin belong to Terciary (Iocene and Oligocene), the age of sediments in between upper and middle parts of Kabul basin about (20 - 45) meliones years, its called Terciary formations[16]. Upper part of these sediments covered by younger sediments of lower Quaternary (Plasetocene) sediments and its consists of these terracese, it have different complex, altitudes and locations, for example upper part of Kabul river basin is belonging to Quaternary and there we can see more consolidated and unconsolidated gravels sediments, but middle part of Kabul river basin belong to Terciary and there is some unconsolidated sands, Marles (gray, white, green and brown) colores, and upper part of these sediments covered by rivers terracese[7]. All mountains surrounding of Kabul provnce, made by metamorphic rocks, with out Paghman mountains in adation metamorphic rocks, its made by some Igneouse rocks also, othere all mountain made from metamorphic rocks, from Radio metry method they find the life time of these mountains about (928 ± 8) melion years ago [16] . The older one is located at the Khear Khana mounrains and younger is in Shawaky and Qorugh mountains range[2].

4.1 Location of Terraces

The middle terrace of Paghman river is located at (1935 m a.s.l.) , 34°. 313′ 445″ latitud and 069°. 020′ 547″ longitud, lower terrace of this river is (1823 m a.s.l.), 34°. 312′ 833″ latituth and 069°. 021′ 782″ longitude, upper terrace of Kabul river at the Maranjan hill at (1423 m a.s.l.), 34. 311′ 132″ latitude and 069 °. 121′ 909″ longitude, middle terrace of Kabul and Loger rivers at Nawruzaba **(**1329 m a.s.l.), 34°. 313′ 107″ lititude and 069°. 180′ 027″ longitude, upper Terrace of Kabul and Loger rivers at Polycharghy (1791 m a.s.l.), 34°.331′ 934″ lititude and 069 °. 174′ 113″ longititude. Because its relief is from west to east mean that the slope this area is from west to east, high altitude is at the paghman mountain range (4522 m a.s.l.) and the down area is located at Tangi Maheeypare its (800 m a.s.l.).

4.2 Gravel Analysis

From gravel analysis found different kinds of particals according to the location of terracese. In this particals bigger from 6.3 mm size. Paghman River at Baghadawood hill 87 % granite, 9 % Quarsite and 4 % Gnaize (fig.2). Size bigger is 8×10 cm and smaller is 7×7 mm.

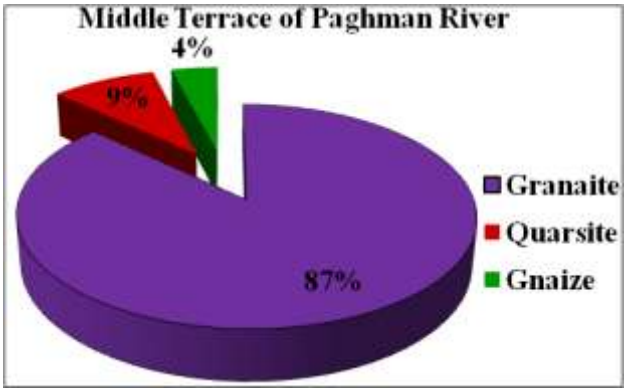

Figure 2: Number of different gravels at the middile terrace of Paghman riverat the Baghadawood hill

In lower terrace of this river is Granite 77 %, Quarsite 22 % and Gnaize 1 % (Fig.3), and bigger size 9×9 cm and smaller is 6×7 mm. if we compare two terraces, we can find more Granite because its transports from Paghman mountain in that time by water and in these terracese accumulated.

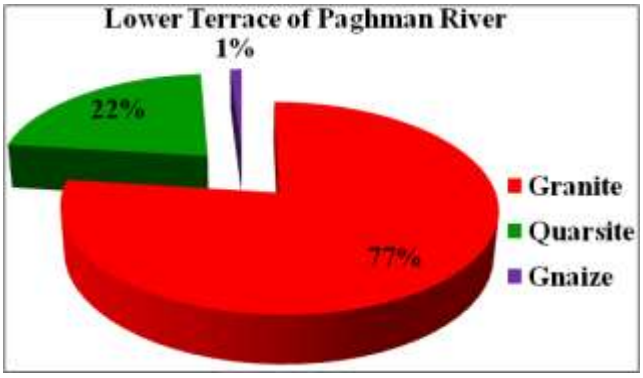

Figure 3: Numbers of different gravels at the lower terrace of Paghman River at the Baghadawood hill

In upper terrace of Kabul river at the Maranjan hill, metamorphic (Pholite) 84 %, Quarsite 13 % and Granite 3 % (fig.4), from these gravels the bigger one is 7×8 cm and smaller is 6.6× 7 mm in this terrace the percentage of metamorphic is more than others rocks its transport by water from south west and north west mountains of Kabul and its made by crytaline.

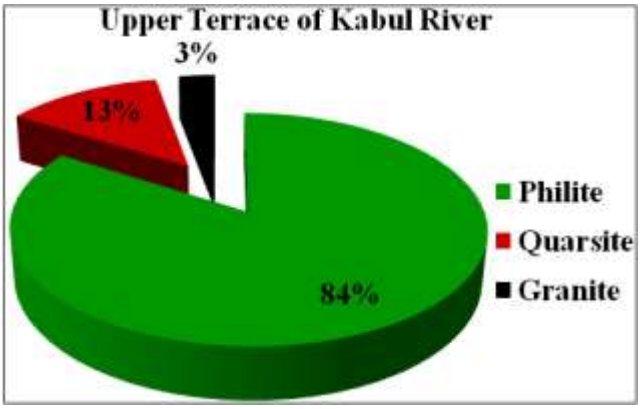

Figure 4: Numbers of different gravels gravels at the upper terrace of Kabul River at the Maranjan hill

In middle terrace of Kabul and Logger rivers at the Naurozabad, Pegmatite 1 %, Sederite 10 %, Qarsite 36 %

and Gnaize 53 % (Fig.5), from these sizes the bigger one is 7 × 10 cm and smaller one is 6.5×7 mm.

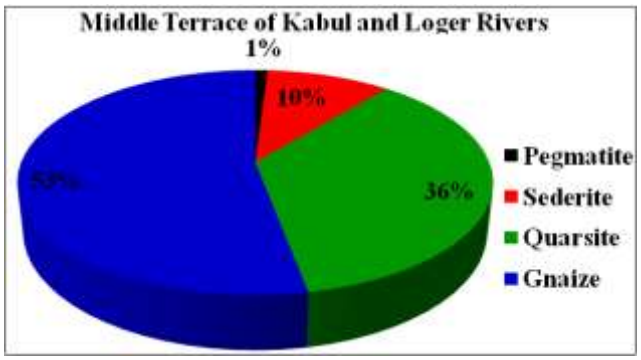

Figure 5: Numbers of different gavels at the middle terrace of Kabul and Loger rivers at the Nuaruzabad

in upper terrace of Kabul and Logger rivers at the Polycharkhy Carbonate (Limeston) 1 % Schist 2 %, Quarsite 22 % Metamorphic rocks (Pholite) 35 % and 40 % (Fig.6), Gnaize bigger one is 9× 10 cm and smaller one is 6.8 ×6.5 mm. If look here in these two terraces there also we can find more metamorphic rocks because these also transport from surrounding metamorphic (crystalline) of Kabul by water on that time.

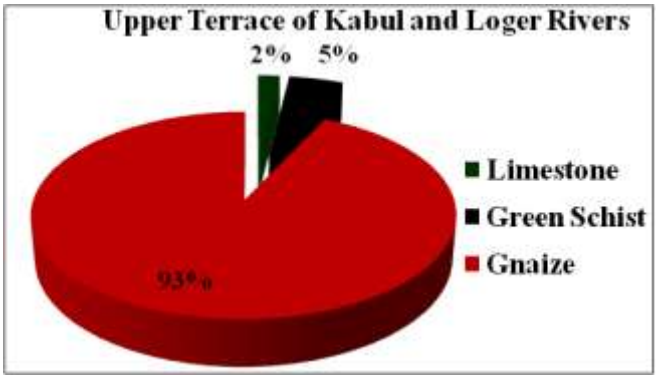

Figure 6: Numbers of different gravels at the upper terrace of Kabul and loger rivers at the Polychakhy

4.3 Sieving Analysis

After gravel analysis method we done seving analysis method in this method we prepared 300 gr first materials and we analysis different size of particals (6.3 mm, 2 mm, 1 mm, 500 µm, 250 µm, 125 µm, 6.3 µm and Rest). From seving analysis method we achieved the following Percentage of different size (Fig. 7 and 8).

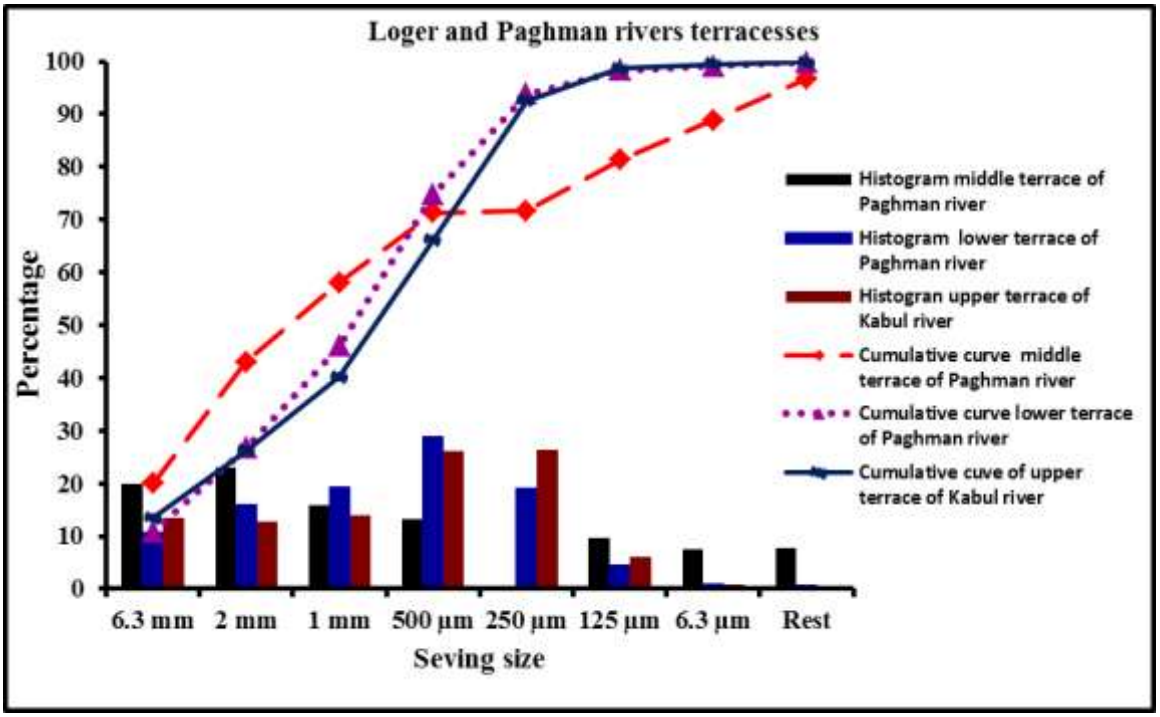

Figure 7: Cumulative Curve and histogram of middle, lower terraces of Paghman and Kabul Rivers at the Baghadawood and Maranjan hills

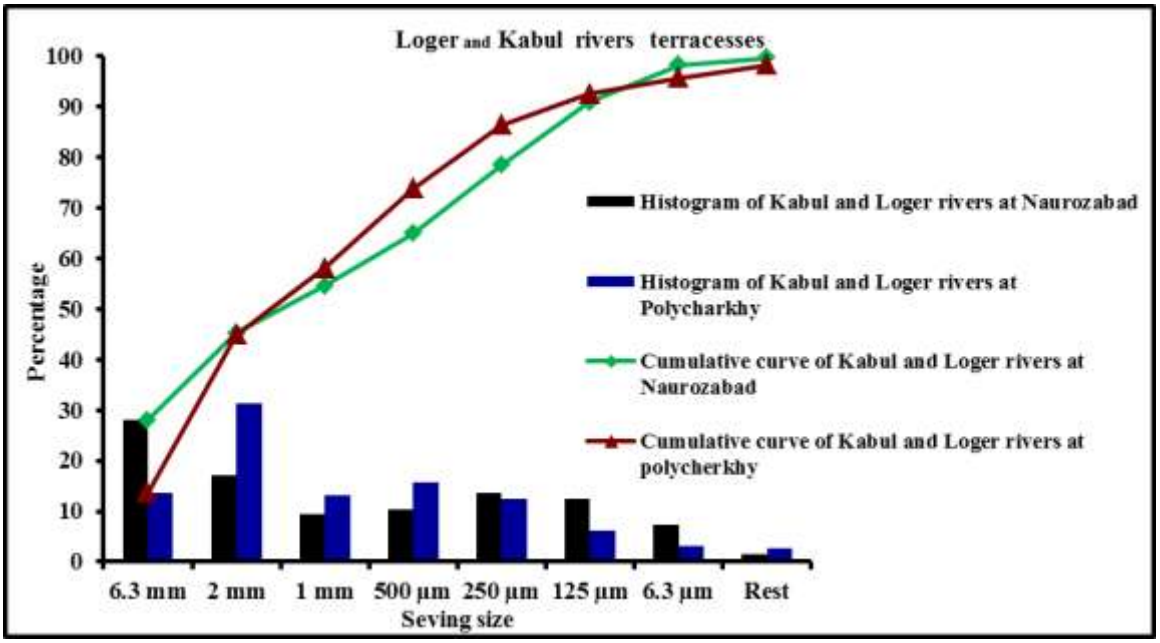

Figure 8: Cumulative Curve and histogram of Kabul and Loger rivers at Naurozabad and Polycharkhy Middle and upper terraces

4.4 Heavy and Light Minerals

When we mixed the materials of 125 µm with 6.3 µm in laboratory and we fut this materials in the chemical solution of Bromoform and we found the following heavy and light minerals. Shown in table 1 and table 2 we can fined that there is more number of heavy minerals and heavy minerals also different according to the loction of terraces for example if we looke at the two terraces of Paghman river at the Baghadawood hill compare with Kabul river terrace at the Maranjan hill and Kabul (fig.9, 10, 11, 12, 13, 14), and Logger rivers terraces at the Polycharkhy and Nawruzabad we can see Epidote, Garnite and Staurolite more than in two terraces of Kabul and logger rivers because of Crystalline of Kabul but in Paghman river we can find more Rutile , Hornbland, Zercone and Turmaline because there is Igneouse rocks of Paghman mountains its transported by water on that time. Some light minerals for example Muscuvite, Biotite in all terraces of upper and lower Kabul basin we can find because these two kinds of minerals in both metamorphic and we can find in igneous rocks, as well as if we compare Biotite mineral between two terraces of Paghman river we can find that there is erosion of Paghman igneous rocks from other hand there is different of erosion between terraces.also more Amphibole mineral in Paghman river terraces ,because of Paghman mountain igneous rocks, as well as Turmalin and Zercon minerals in upper terrace of Kabul river at the maranjan hill because Kabul river starts from Paghman mountain as wel as in Gazarga region join with the Paghman river (Fig.15, 16, 17,18). For good underastanding we can see same percentage in graphs also. The percentage of heavy and light minerals at the at the upper and lower Kabul basin in tabals 1 and 2 are explained.

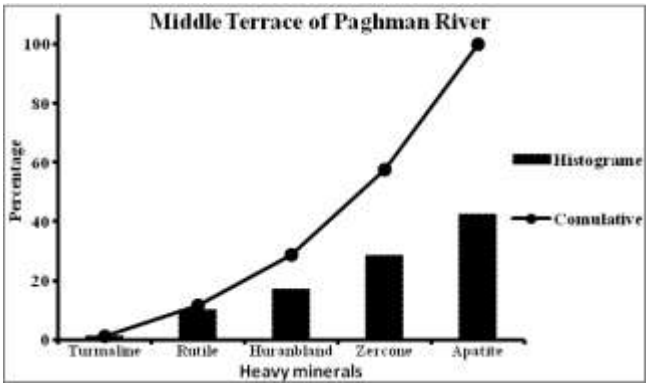

Figure 9: Cumulative curve and histogram of heavy minerals of middle terrace of Paghman River

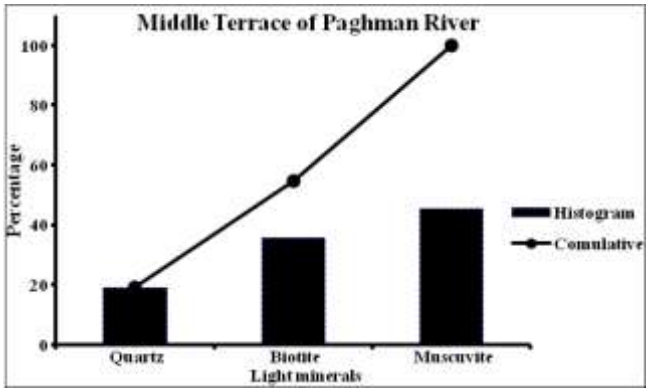

Figure 10: Cumulative curve and histogram of light minerals middle terrace of Paghman River at the Baghadawood hill.

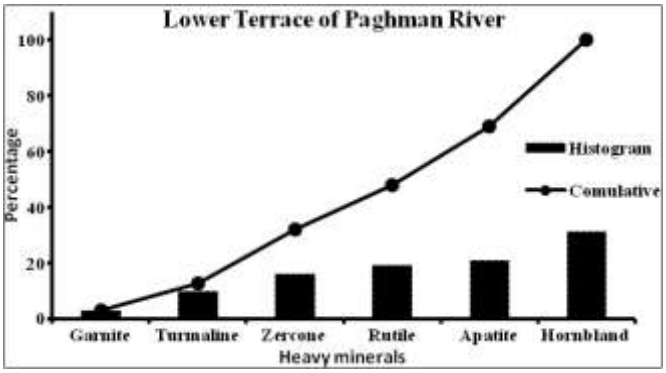

Figure 11: Cumulative curve and histogram of heavy minerals of lower terrace at the Baghadawood hill

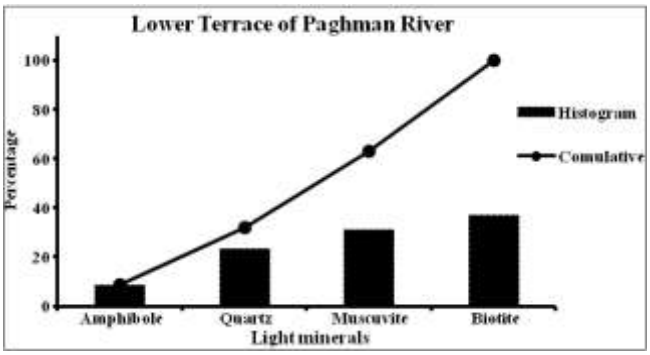

Figure 12: Cumulative curve and histogram of light at the lower terrace of Baghadawood hillf

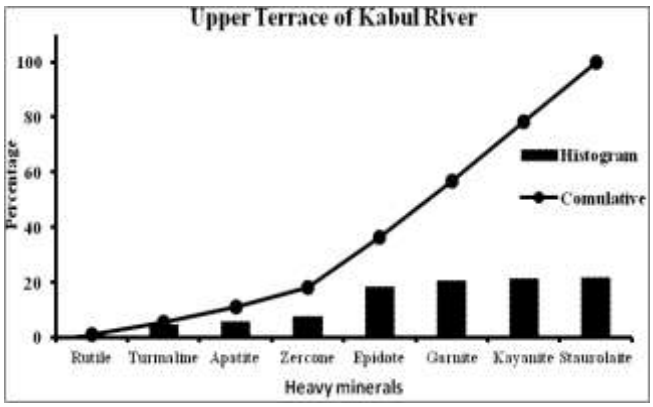

Figure 13: Cumulative curve and histogram of heavy mineral upper terrce of Kabul River at the Maranjan hill

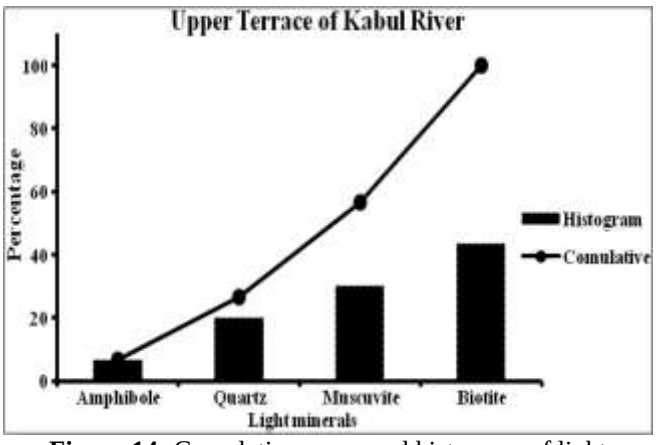

Figure 14: Cumulative curve and histogram of light minerals of upper terrace at the Manjan hill

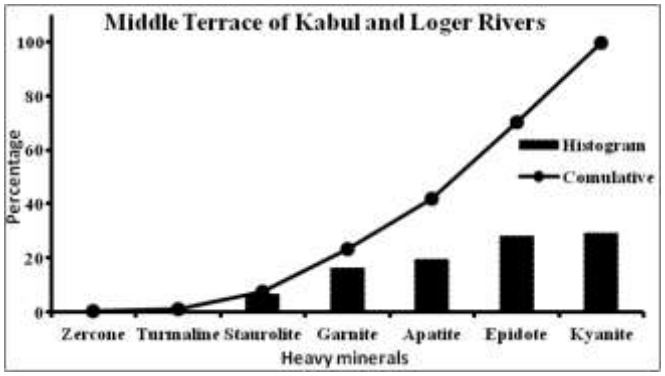

Figure 15: Cumulative cueve and histogram of heavy minerals of middle terrace Kabul and Loger rivers at the Nawruzabad

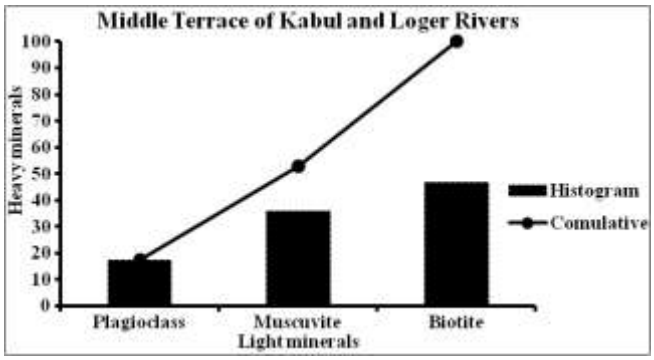

Figure 16: Cumulative curve and histogram of light minerals middle terrace of Kabul and Loger Rivers at the Nawruzabad

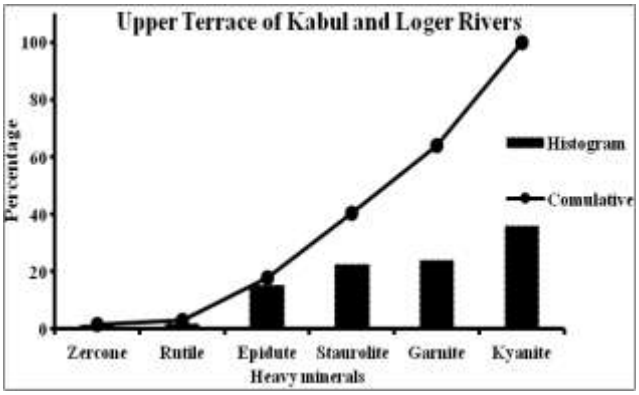

Figure 17: Cumultive curve and histogram of heavy minerals upper terrace of Kabul and Loger Rivers at the Polycharkhy

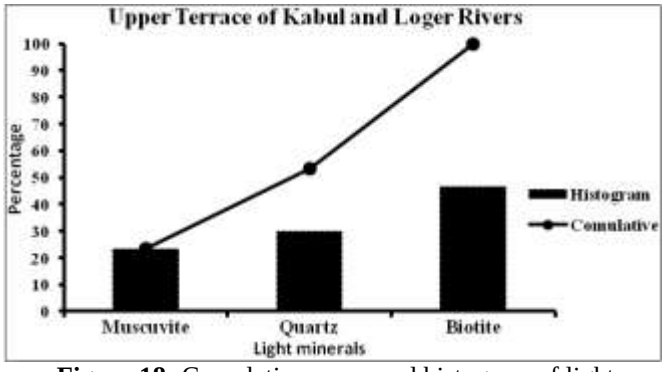

Figure 18: Cumulative curve and histogram of light minerals upper terrace of Kabul and Loger Rivers at the Polycharkhy

Table 1: +n

Percentage	Minerals	Location	Type	River
1.3	Turmaline	Baghadawood	Middle	Paghman
10.26	Rutile	//	//	//
17.30	Hornbland	//	//	//
28.6	Zercone	//	//	//
42.56	Apatite	//	//	//
2.85	Garnite	//	Lower	//
9.92	Turmaline	//	//	//
16.12	Zercone	//	//	//
19.12	Rutile	//	//	//
20.87	Apatite	//	//	//
31.14	Hurnbland	//	//	//
0.98	Rutle	Maranjan	Upper	Kabul
4.42	Turmaline	//	//	//
5.49	Apatite	//	//	//
7.31	Zercone	//	//	//
18.14	Epidote	//	//	//
20.59	Garnite	//	//	//
21.35	Kyanite	//	//	//
21.69	Staurolite	//	//	//
0.148	Zercone	Nawruzabad	Middle	Loger
0.255	Turmaline	//	//	//
6.51	Staurolite	//	//	//
16.26	Garnite	//	//	//
19.40	Apatite	//	//	//
28.25	Epidote	//	//	//
29.17	Kyanite	//	//	//
1.37	Zercone	Polycharkhy	Upper	Kabul and Loger
1.49	Rutile	//	//	//
15	Epidote	//	//	//
22.35	Staurolite	//	//	//
23.85	Garnite	//	//	//
35.92	Kyanite	//	//	//

Table 2: light minerals at the three terraces of Kabul, Loger and Paghman Rivers at the upper and middle parts of Kabul sedimentary basins

Percentage	Minerals	Location	Type	River
19.09	Quartz	Baghadawood	Middle	Paghman
35.6	Biotite	//	//	//
45.3	Muscuvite	//	//	//
8.71	Ampibule	//	Lower	//
23.33	Quartz	//	//	//
30.95	Muscuvite	//	//	//
37	Biotite	//	//	//
6.7	Amphibole	Maranjan	Upper	Kabul
20.1	Quartz	//	//	//
30 %	Muscovite	//	//	//
43.3	Biotite	//	//	//
17.42	Plagioclase	Nawruzabad	Middle	Loger
35.7	Muscovite	//	//	//
46.85	Biotite	//	//	//
23.3	Muscuvite	Polycharkhy	Upper	Kabul and Loger
30	Quartz	//	//	//
46.6	Biotite	//	//	//

Defination of some Heavy Mineral belong to this Research

Table 3: Chemical formula and related elements of heavy minerals [11]

Elements	Chemical Formola	Heavy Minerals
Ca.Fe	$Ca_2 (Al Fe)_3 (Si_2O_7) (SiO_2) O (OH)$-	Epidote
Ca	$Ca_5(F.cl.cu x po_4)_3$	Apatite
Al	$Al_2 Sio_5$	Kyanite
Al	$Fe_3 Al_2 (Sio_4)_4$	Garnite
Fe.Al	$FeAl_9 O_6 (Sio_4)_4 (O.OH)_2$	Staurolite
Fe.Mg.Al	$NaCa_2 (Mg.Fe.Al)_6(Si.Al)_8 O_{22} (OH)_2$	Hornbland
Zr	$Zr (SiO_4)$	Zercone
Ti	TiO_2	Rutile
Mg . Fe . Al	$Na (Mg, Fe)_3Al_6(Bo_3)_2(Si_6O1_8)(OH)_4$	Turmaline

Table 4*:* Chemical formula and related elements of light minerals [11]

Elements	Chemical Formula	LightMinerals
K	$K_2 Al_4 (Ai_6 Al_2) O_{20} (OH)_4$	Muscuvite
K	Sio_2	Quartz
K . Mg . Fe	$K_2 (Mg . Fe) (Si_6 Al_2) O_2 (OH)_4$	Biotite
Si.Mg	$Mg_7 (Si_4 O11)_2 (OH)_2$	Ampibule
Na	$Na Al Si_3O_8$	Albite

5. Conclusion

This Sedimentological research is used to selected different size and type of river sediments transported by Kabul, Loger and Paghman rivers discharges in upper and middle parts of Kabul basin in Afghanistan for the previous geological periods. From analysis, in middle terrace of Paghman river, Granaite 87 %, Quarsite 9 % and Gnaize 4 %, bigger size is 8 ×10 cm and smaller is 7× 7 mm. in lower terrace of this river, Granite 77 %, Quarsite 22 % and Gnaize 1 %, bigger size is 9× 9 cm and smaller is 6× 7 mm, in upper terrace of Maranjan hill, metamorphic rocks (pholith) 84 %, Quarsite 13 % and Grainte 3 %, bigger size is 7× 8 cm and smaller is 6.6× 7 mm, in the middle terrace of Nawruzabad hill, Pegmatite 1 %, Sederite 10 %, Quarsite 36 % and Gniaze 53 % , the bigger size is 7× 10 cm and smaller size is 6.5× 7 mm, in the upper terrace of Polycharkhy hill, Limestone 2 %, Green schist 5 %, Gnaize 93 % , bigger size is 9× 10 cm and smaller is 6.5×6.8 mm, respectively. The results obtained suggest that the Sedimentological research can be used efficiently in the other catchments of basin and other mountain basins in Afghanistan.

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