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ARTICLE

Investigations on River Sediments in Chak Sedimentary Basin, Wardak Province, Afghanistan

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ABSTRACT

This sedimentary is from a largest basin of Afghanistan, which covers an area of 9772 km2. It is located about 80 km, at west side of Kabul. In this research, we studied different types of heavy and light minerals, gravel analysis in river sediments. Logar River is core stream flowing over basin, it carries diverse masses of sediments from dissimilar parts of surroding montians. Further, in the months of summer while snowmelting is started, transfer diverse materials and cause different traces to be made. Area of basin is enclosed by mountain range and separated into two sections, majore part is Khawat Olya and second one is Khawat Sufla. The main aim of study is to characterize different sizes and types of minerals in river load for the previous geological periods. This research is therefore essential to explain different sizes and type of minerals in river sediments, which is no any study has been conducted in the study area. This study found out that the category of sediments is related to the parental materials that are placed in the close mountains such as; gneiss, limestone, and granite, dissimilar varities of conglomerate, slate, schist, reefs, conglomerate and sandston.

1. Introduction

As it is clear, we have been suffering from clashes for more than forty years. So, geological researches have not been conducted in this equivalent basin (Chack Basin). Thus, as research in this basin is very important due to its importance and before some researches might be conducted, but were not be like this one. Therefore, we decided to work hard and conduct this geological research. Chak Basin is one of the biggest basins in Afghanistan that has 9772 km^2 area and is surrounded by high mountains ranges. Further, nature of sediments which are in this basin directly related to the parent rocks those are located in the nearby mountains such as gneiss, limestone, granite, conglomerates, slate, schist, reefs and sandstone [1-26].

The Chak Sedimentary Basin is surrounded by Wardak Mountain series, the maximum height reaching 3500 ① m a.s.l, in Daimirdad, Wardak Mountain range, and least height is 2092 m a.s.positioned in Ambokhak village, the

① m a. s. l = meter average sea level

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Paghman Mountains in the direction of the east side of study area. Heights of the central plains range from about 2200 m in the Central Chak Basin and subbasins to 2900 m in the Asiab, Bigsamend, Alisha then Gardan Masjeed subbasins [1]. In Chak Basin the Loger River is the main streams transitory over this basin and via streams from mountain regions transported dissimilar particles and kinds of sediments throughout snow-melting period (from April to June), occasionally during flush floods seasons (May to August) transference altered bulks of sediments and falling by one another creation dissimilar beds and terraces [2]. The forms of sediments is connected to the rocks that are placed and fragmented by unlike types of exogenetic powers in the near mountains and transported by watercourses at the priorer geological stages [3]. Study area strike is similar longitudinal valley and it is parallel with the mountain states [4]. Younger deposits from different parts of this basin based on their depth and arrangement are changed according to the settings, for example, the upper and steep areas of this basin are not very thick and they belong to the Quaternary Period [5], and commonly involves conglomerate but nonetheless the lower basin consisting of young tertiar sediments and normally containing of different clay, silt,sand and gravels.The landforms inside the basin are characteristics of a dry to semiarid, technically dynamic regions [7,6]. In the central plains of the Chak Basin are local depositional centers for sediments resulting from the adjoining surficial deposits and bedrocks outcrops [8]. The central parts gradually elevation towards the neighboring mountains and hills to piedmonts [8]. Alluvial fans have established on the margins of the mountains close the ChakWardak basin and on interbrain ridges.The alluvial fans generally grade beginning coarse materials nearby source to finer materials on the distal edge.Physical weathering brought via risky temperature variations takes created breakdown in elevation at the edge of the basin [9,10]. This permanent weathering route maintains the steep, rocky mountain slope.This basin is portion of the dynamically tectonic of Kabul Mass in the transpresional plate borderline region of Afghanistan [11]. The north eastern parts of Chak Depositional Basin is distinct by Paghman fault system [12]. The Paghman fault movement north toward northeast and is evident in the continues fault scarp and piedmont alluvium the north eastern border of this basin.The Chak basin can be defined a valley fill basin and range setting where the valleys are filled with Quaternary and tertiary sediments, and the ranges are composed of uplifted crystalline and sedimentary rocks [13]. Quaternary sediments are classically fewer 80 m thick in the valleys [14,16]. The underlying tertiary depositions have been estimated to be as much as 800 m thick in the city of Kabul [15,27]. Also possibly additional 1000 m thick in certain areas of the valley [17,28]. The Quaternary and Tertiary remains and rocks have been categorized by divides the sediments into younger and older basin deposits [19,20]. The younger deposits, reworked loess series, are described as reworked loess, gravel, sand and talus. The gavel and were deposited mostly in the river channels [29,30].

The main objective of this research is to find out heavy and light minerals, gravel analysis for determining the quality of rocks as well as the types of mineral in river terraces. This research is important for industrial, geology, construction material, arts in the equivalent ministries and other organizations in Afghanistan. The reason that I prefer this research to be conducted is that such researches have not been conducted before in Afghanistan, if conducted couldn't response the needs of time.

The challenges that I faced during this research are; lack of research in this area and lack of geological equipment for research.

2. Study Locations

This inquiry carried out in the particular geological features and three altered terraces (upper, middle and lower) of Chak District (Figure 1) [22,23]. This is located at the south west side of Kabul happening Hindu Kush Mountain range in Afghanistan. The Chak Wardak Basin hiding place an area of 9772 km^2 with a maximum altitude of 3500 m in Wardak Daimirdak Mountain range and least elevation is 2092 m positioned in Ambokhak [24,26]. Loger River is one of the very significant streams of this district and it's started from (3500 m a.s. l) Daimirdad Mountain (Wardak range related Hindu Kush mountain range in Afghanistan) belong to Wardak Province [25]. At the first steps this river flows from west to east, and pass from Chack and Saidabad Districts in Wardak Province and then enters into Loger Province and it joins with Charkh River in Barakibarak District of Logar Province. After that, it enters to Kabul Province and juncture with Kabul River at the Sheena village related to the Bagramy District [26].

3. Method and Materials

In this exploration we studies different river terraces. From every terrace we got 1 kg sample and analysed in the test room of geology, Kabul University.The bigger size is boulders (50×80 cm), and smaller size is silt. For extrication smaller size we done sedimentological analysis and we used different size of sieving as shown in Figures 7 and 8. For separating heavy and light minerals, we mixed sediment fractions that are passing from 6.2

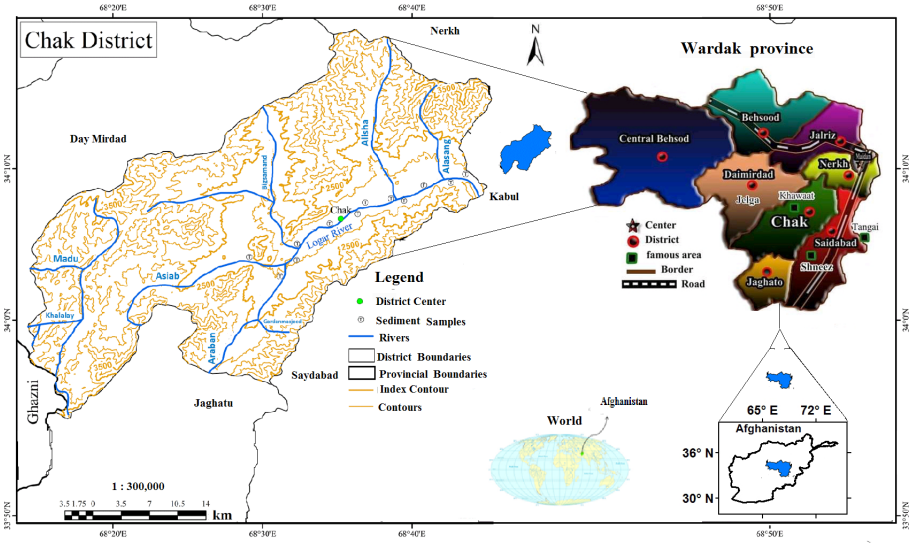

Figure 1. Geological setting of study locations, Wardak, Afghanistan.

mμ and150 mμ sieving sizes and mixed with one another, from these we got 300 mgr (milli gram) sample and put in the chemical solution of Bromoform (2.8 gr/cm^3), and for 24 hours staying in this chemical solution after 24 hours light minerals was at the suspension condition, and heavy minerals was precipitated at this solution, after we dried at the 30^{0}C of temperature, and we made thin section for determination type of heavy and light minerals we used polyresasion microscoph, at the result achieved different type of heavy and light minerals as shown in Tables 1 and 2. From bigger sizes (Pebbl, Granul) we did gravel analysis method to find different kinds of rocks.

4. Results and Discussion

Small and bigger tributaries at the different locations of Khawat Olya and Sufla junction with Loger River streams, normally these flows after west to east. The diverse kinds of sediments inter mountain backing basin accumulation and one by others making different kinds of terraces. The sediments inter mountain basin belonging near the tertiary (Iocene and Oligocene). It is about 20-45 million years old and its name is tertiary formation. At the higher parts of these sediments found not the same terraces it's related to the lower tertiary (Pleistocene) and it's younger than lower sediments. The slopes of Chak Basin are in north west to south east that belong to the relief of this basin from Daimirdad 3500 m to Ambokhak 2092 m [19]. The thickness of younger sediments between inter mountains backing basin belonging to the form of basin and distance from mountains ranges. The depth of sediments close to the source consolidated angular gravels and at the plains areas generally soft clay, silt, sand and some rounded gravels. The thickness of sediments at the plain areas at the Chak Dam is more than 1500 m and generally its clay, silt and sand. The quality and quantity of deposits in Chak Basin belonging near the adjacent mountains and that weathered by exogenetic force and transported by different phenomenon of gravity, waters, winds and made different types of sediment layers at the different location of basin. From sediments samples we found epidote, kyanite, muscovite, biotite and grarnet minerals belong to all metamorphic rocks that are located in surrounding mountains, others minerals rutile, biotite, and zircon because these belong to igneouse rocks.

4.1 Gravel Analysis

In this part of research, we got from five terraces different bigger sizes of gravels (Cobbles, Pebbles, granuls, grites). The sizes of terrace gravels belong to the slope and distance from mountains ranges, the formations of that terraces located near to the mountains and slope areas. Generally, there are bigger sizes in terraces, but apositlly those are far from mountain ranges and plains areas composetes from smaller sizes of gravels. From gravel analysis of lower terrace of Najuya we find different kinds of gravels according to the location of terrace. In this terrace 80% Limestone, 16% Quarsite and 4% Gnaize (Figure 2). Size bigger is 11×15 cm and smaller is 5×6 mm.

In lower terrace of Baghcha being limestone 70%, quarzite 20% and gneiss 10% (Figure 3), the bigger size is 10×10 cm and the smaller is 6 × 6 mm. If we compare two terraces, we can find more limestone because of surrounding mountains of bomb, and that are transported by water and deposited in these terraces. In this existing more than bigger particles on the river bed slope.

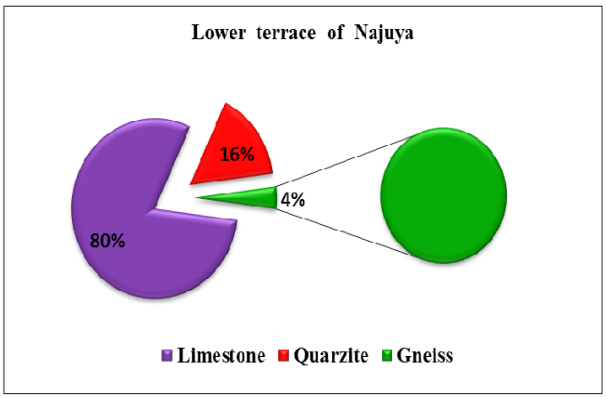

Figure 2. the percentage of rock type gravels in the formation lower terrace of Najuya.

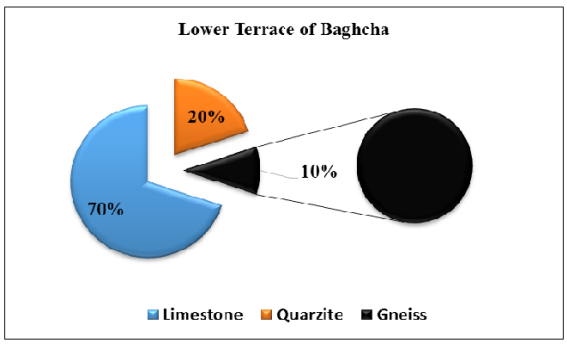

Figure 3. Different percentage rock type at gravels in lower terrace of Baghcha.

In the middle terrace of Baghcha, being gneiss 80%, guarzite 10% and granite 10% (Figure 4), bigger is 9×8 cm and smaller is 6 ×7 mm, in this terrace the percentage of gneiss is more than others rocks, because of surrounding mountains that are transported by water from south west and north west mountains of wardak.

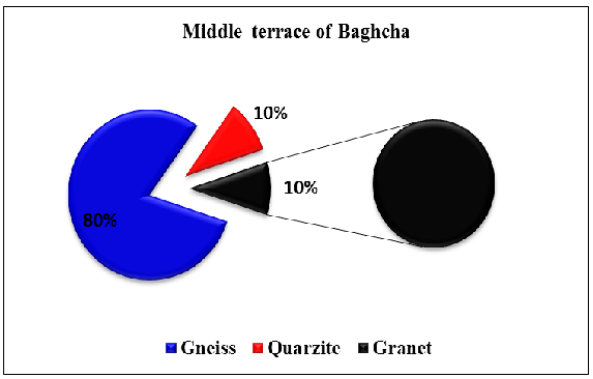

Figure 4. Different percentage rock type at gravels in middle terrace of Baghcha.

In middle terrace (molase) of west side of dam, being pegmatite 10%, conglomerate 30%, qarzite 50% and gneiss 10% (Figure 5), from these sizes the bigger one is 10× 11 cm and smaller one is 5× 6 mm.

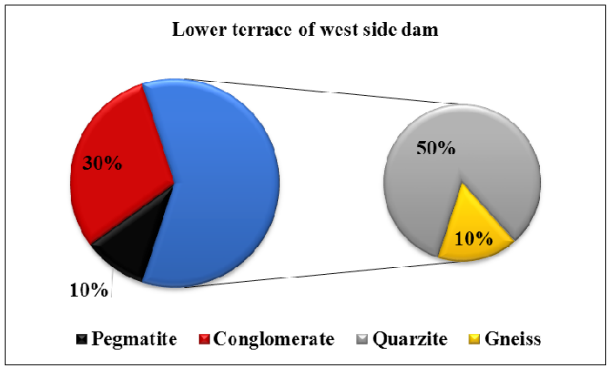

Figure 5. Different percentage rock type at gravels in lower terrace of west side of Chak dam.

In this limestone being 50% green schist 10%, and quarzite 40% (Figure 6), gneiss bigger one is 10 ×9 cm and smaller one is 6 × 5 mm. If look here, in these two terraces, we can find more metamorphic rocks there because these also transport from surrounding metamorphic (crystalline) of Kabul by water on that time.

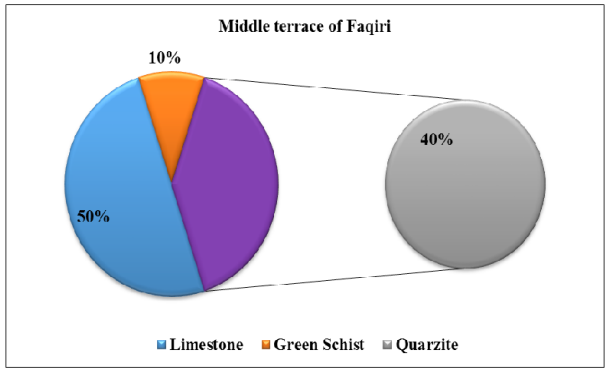

Figure 6. Different percentage rock type at gravels in middle terrace of Faqiri.

4.2 Sieving Analysis

After gravel analysis method we did sieving analysis method in this method we prepared different sizes and we got at the weight of 300 gr (gram) from every terraces and analyzed different sizes by sieving analysis method. In this method we achieved the following percentage of different sizes (Figure 7 and 8).

4.3 Heavy and Light Minerals

For heavy and light minerals studies in laboratory we mixed the sieving sizes of 125 µm (milli micron) with 6.3 µm and we futing these materials at the wight 30 mgr in the chemical solution of Bromoform (2.8 gr.cm^{-3}) and we found different heavy and light minerals. As shown in Tables 1 and 2 and Figure 9, 10, 11, 12, 13, 14, we can find a number of heavy and light minerals. In this research we

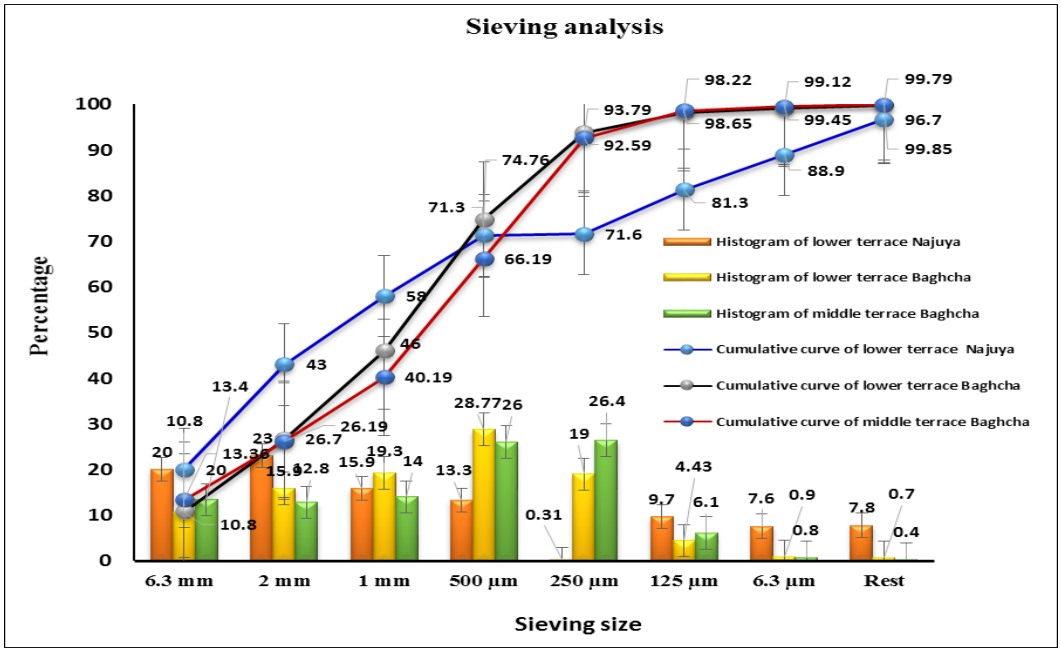

Figure 7. Cumulative Curve and histogram of middle, lower terraces of Najuya and Baghcha at the Chak, Wardak.

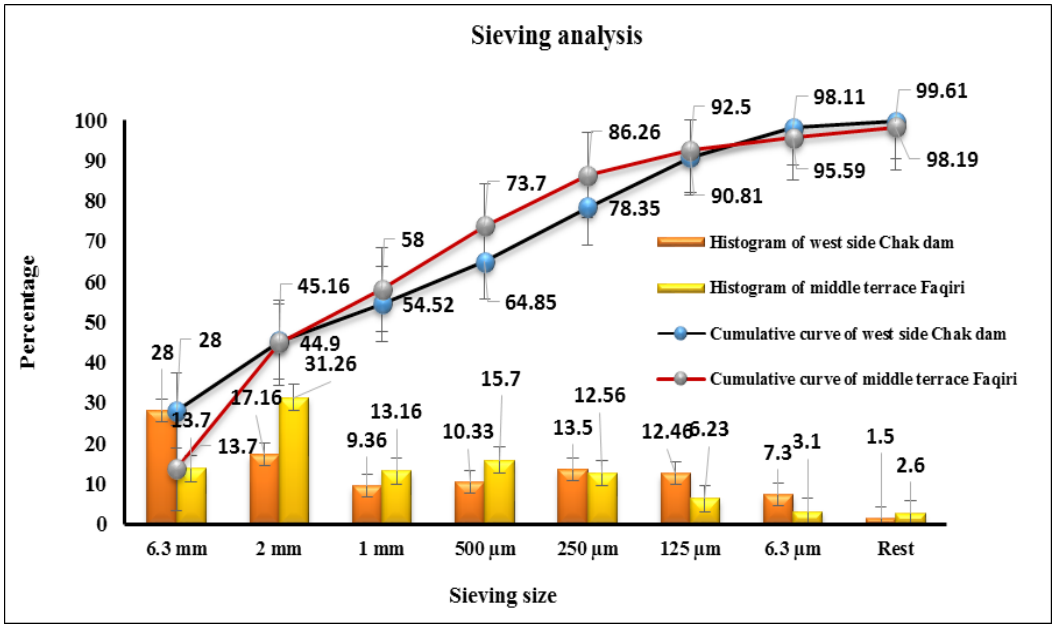

Figure 8. Cumulative Curve and histogram of lower and middle terraces of west side Chak dam and Faqiri at the Chak, Wardak.

found minerals of epidote, garnet and staurolite more than in Madukhel mountains range that is transported by water to Baghcha and Chak Dam terraces rutile, hornblende, zircon and tourmaline minerals, because of igneouse rocks at the Gardan Masjid surrounding mountains it's transported by water at the different times. Some light minerals for example muscovite, biotite in all terraces of middle and lower because these two kinds' minerals we can find in both metamorphic and igneous rocks that are located in mountains. As well as if we compare biotite mineral between Faqiri and Najuya terraces achieving that there is erosion of igneous rocks at mountains and it's deposited in these terraces. Also amphibole mineral in terraces, because of Gardam Masjid mountain igneous rocks. As well as tourmaline and zircon minerals because Gardam Musjeed mountain (Figure 15, 16, 17, 18). For good understanding also we can see some percentage in graphs. The percentage of heavy and light minerals in the Tables 1 and 2 are detail explained.

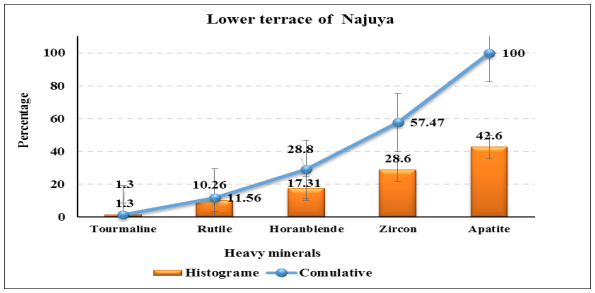

Figure 9. Cumulative curve and histogram of heavy minerals of lower terrace of Najuya.

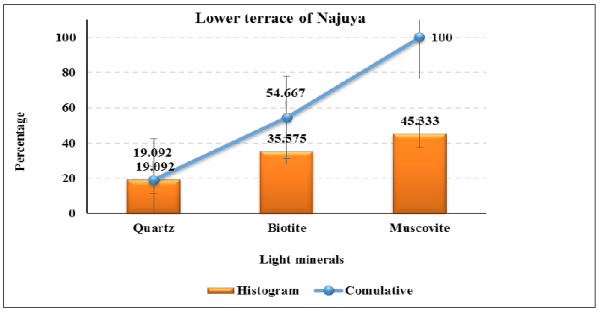

Figure 10. Cumulative curve and histogram of light minerals of lower terrace of Najuya.

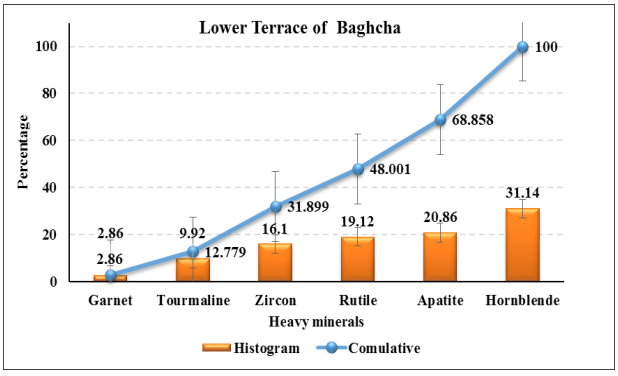

Figure 11. Cumulative curve and histogram of heavy minerals lower terrace of Baghcha.

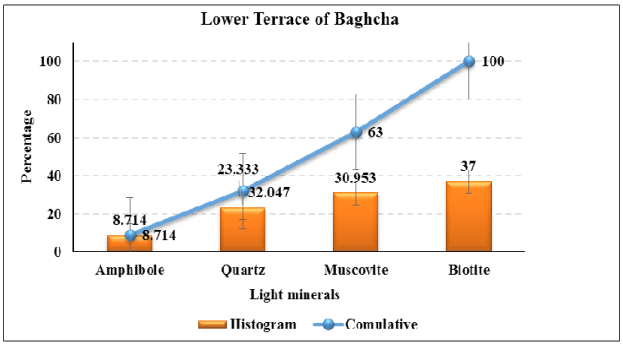

Figure 12. Cumulative curve and histogram of light at the lower terrace of Baghcha.

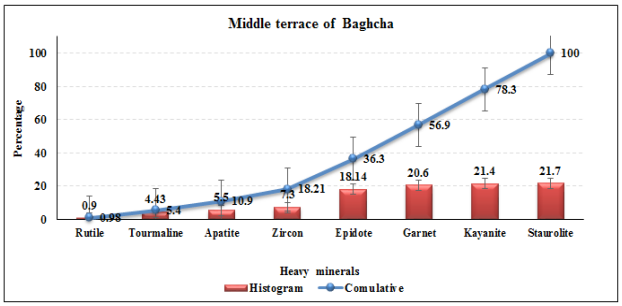

Figure 13. Cumulative curve and histogram of heavy minerals middle terrace of Baghcha.

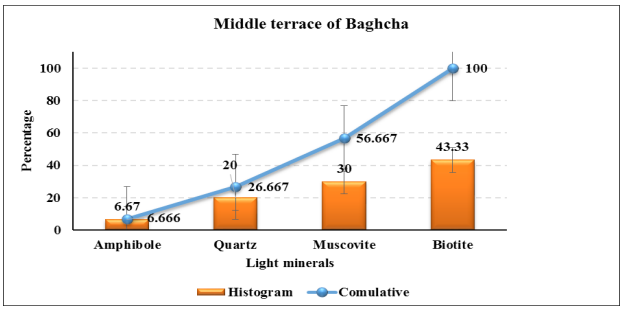

Figure 14. Cumulative curve and histogram of light minerals middle terrace of Baghcha.

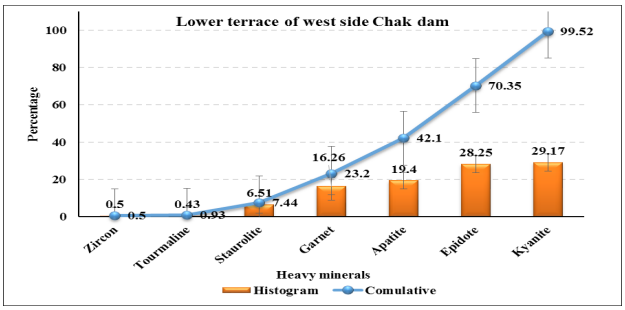

Figure 15. Cumulative cueve and histogram of heavy minerals of lower terrace west side Chak dam.

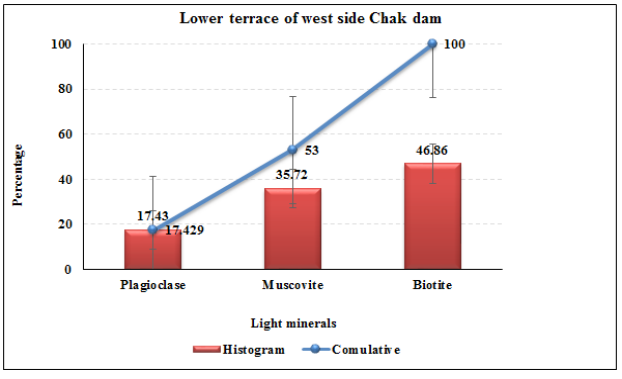

Figure 16. Cumulative curve and histogram of light mineralsLower terrace of west side Chak dam.

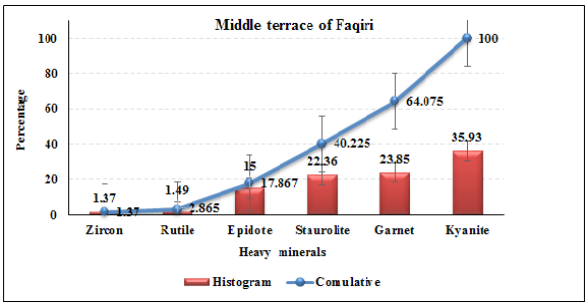

Figure 17. Cumultive curve and histogram of heavy minerals Middle terrace of Faqiri.

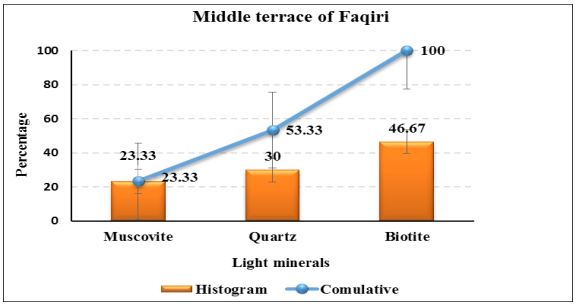

Figure 18. Cumulative curve and histogram of light minerals middle terrace of Faqiri.

Table 1. Summary of heavy minerals of this research

River sediments	Locations	Minerals	Percentage
Loger River	lower terrace of Najuya	Tourmaline	1.3
≈	≈	Rutile	10.26
≈	≈	Hornblende	17.30
≈	≈	Zircon	28.6
≈	≈	Apatite	42.56
≈	lower terrace of Baghcha	Garnet	2.86
≈	≈	Tourmaline	9.92
≈	≈	Zircon	16.1
≈	≈	Rutile	19.12
≈	≈	Apatite	20.87
≈	≈	Hurnblende	31.14
≈	middle terrace of Baghcha	Rutile	0.9
≈	≈	Tourmaline	4.42
≈	≈	Apatite	5.5
≈	≈	Zircon	7.3
≈	≈	Epidote	18.14
≈	≈	Garnet	20.6
≈	≈	Kayanite	21.4
≈	≈	Staurolite	21.7
≈	lower terrace west side Chak dam	Zircon	0.5
≈	≈	Tourmaline	0.43
≈	≈	Staurolite	6.51
≈	≈	Garnet	16.26
≈	≈	Apatite	19.4
≈	≈	Epidote	28.25
≈	≈	Kyanite	29.17
≈	Middle terrace of Faqiri	Zircon	1.37
≈	≈	Rutile	1.49
≈	≈	Epidote	15
≈	≈	Staurolite	22.36
≈	≈	Garnet	23.85
≈	≈	Kyanite	35.93

Table 2. Summary of Light minerals of this research

River sediments	Locations	minerals	Percentage
Loger River	lower terrace of Najuya	Quartz	19.09
≈	≈	Biotite	35.5
≈	≈	Muscovite	45.3
≈	lower terrace of Baghcha	Amphibole	8.71
≈	≈	Quartz	23.33
≈	≈	Muscovite	30.95
≈	≈	Biotite	37
≈	middle terrace of Baghcha	Amphibole	6.7
≈	≈	Quartz	20.1
≈	≈	Muscovite	30
≈	≈	Biotite	43.3
≈	lower terrace west side Chak dam	Plagioclase	17.42
≈	≈	Muscovite	35.7
≈	≈	Biotite	46.86
≈	Middle terrace of Faqiri	Muscovite	23.3
≈	≈	Quartz	30
≈	≈	Biotite	46.6

5. Conclusions

This geological research used to distinguish different sediments sizes, rock and minerals types in river sediments that are transported at snowmelting season by Loger River discharges from different parts of surrounding mountains in Chak District. At formation of lower terrace in Najuya 80% limestone, 16% quarzite and 4% gneiss, bigger size is 11×15 cm and smaller is 5×6 mm. In lower terrace of Baghcha limestone 70 %, quarzite 20% and gneiss 10%, bigger size is 10×10 cm and smaller is 6 × 6 mm. In middle terrace of Baghcha, gneiss 80%, quarzite 10% and granite 10%, bigger is 9×8 cm and smaller is 6 ×7 mm. In middle terrace of west side dam, pegmatite 10%, conglomerate 30%, qarzite 50% and gneiss 10%, bigger size is 10× 11 cm and smaller is 5× 6 mm. In middle terrace of Faqiri limestone 50% green schist 10%, and quarzite 40%, bigger is 10×9 cm and smaller is 6 × 5 mm. From chemical analysis (Bromoform solution). In the research we found different kind of heavy and light minerals of epidote, garnet, staurolite, rutile, hornblende, zircon and tourmaline, muscovite, biotite, tourmaline, zircon. In this research some heavy minerals such as; epidote, garnet and staurolite related to metamorphic rocks, rutile, hornblende, zircon, amphibole and tourmaline minerals are related to igneouse rocks. Some light minerals such as; muscovite, biotite exist in all terraces, because these two minerals exist in both metamorphic and igneous rocks. All these minerals belong to the surrounding mountains rocks. Those transferred by Loger River in the snowmelting seasons.

The results attained propose that the sedimentological analysis can be used professionally for petrographical, aquifere, geological mapping, stratigraphy, geochronology and engineering geological studies for other mountain basins in Afghanistan.

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