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Geochemical Provenance of Clastic Sedimentary Rocks Case

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Geochemical Provenance of Clastic Sedimentary Rocks Case Study: Wadi Al-Ghar

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Dedication

To my blessed mother, may God save her

My mother, my angel, my love, the rest forever

Dedicated to my great father, rest in peace

Declaration

I certify that this thesis submitted for the degree of Master is the result of my Own research, except where otherwise acknowledged and that this thesis (or Any part of the same) has not been submitted for a higher degree to any other University or institution.

Name: Doha Mahmoud Mohammad Awwad

Signed:

Date: 23/08/2020

Acknowledgment:

Thanks to Almighty Allah, who guided me and created the reasons to finish this study, He gave me strength, determination, perseverance, and patience to complete this research. Peace and blessings be upon to the best human being on earth our Beloved Prophet Mohammed bin Abdullah. All praise is to Almighty Allah for bestowing me with health, opportunity, patience and knowledge to complete this work.

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Abstract:

Sedimentary rocks are considered as a historical record of the different conditions that pass through the region and its composition may be inferred from the development of origin and tectonic setting. Sedimentary rocks are influenced by many factors that create sediments such as chemical weather, climate, and transport. To understand and define the sedimentation environment and its sources, it is important to study geochemical properties. The purpose of this study is to monitor the transport of sediments from one area to another due to surface runoff operations in wadi Al-Ghar area, amount of rain that falls on the area. This study was conducted by estimating the rainfall amounts, then studying the chemical and physical properties of the moving sediments. Where wadi Al-Ghar region is exposed to deep floods from the surrounding areas, the study area was varied in elevation in the range of (400–1000) meters, the slope for the running water was 0.02. These floods affect the geological formation and the arrangement of sand dunes, which are basically sediments are moving from upstream to downstream area. For the methodology we have 48 sediment and runoff samples were collected during two years (2017-2018). The process of collecting samples was in two stages according to Palestine climate wet season (April-May) and dry season (Oct-Nov). Samples point were specified (X,Y,Z) at different altitudes in depth, as it took sediment samples along the stream of the channel more than once to compare the results with each other. The study was divided into several sections: quantities (rainfall) of precipitation, chemical and physical properties of sediments that moved, Rare earth element, isotopes ($\delta 18O$, $\delta 13$ C), organic carbon and total Nitrogen of both sediments and runoff. Results revealed that the wadi divided into five zones based on the names used in that region: Ma'aza, Am-Gresh, Arab rashayda, wadi al-masyada, Confluence of all wadie's and Downstream. Based on

the geological layers exposed in the study area and depending on the ages in which they were formed, the sedimentary rocks in the study area are similar to a part of the sedimentary rocks that formed in the late Cretaceous period, especially the Cenomanian and Toronian periods. Which covers the Hebron Mountains, and this refers to the erosion factors that were exposed to it, which led to its transmission through surface runoff and then deposition in the form of sedimentary dunes in wadi Al-Ghar. Furthermore it ; the results showed that the sediments are presently moving in the same area, and only a small part is transport to the central regions due to the surrounding influences. It is transmitted through various erosion factors such as slope, soil composition, rocks, geological shape and the difficult environmental conditions that the area is exposed to. Also, the results of the trace elements and the main elements confirm that the type of sediments present is dolomite which contains a high percentage of the following elements (Ca, Mg, K, Na), while the REE results were very few> 0.01. This was attributed to the inability to transport the elements by runoff. Surface and lack of a source for high sedimentary masses. Each of the isotopes O18 ((-2.97_ -4.17), δC13 (-6.24_ -2.97) confirmed the presence of limestone in the sediments. However, the values of TOC and TIC and TNb differ between the samples that were taken due to the different sources and their diversity. On the other hand, it was important to study weathering factors on sediments to understand their effect. It was observed that the ratio of CIW and PIW had a positive and disallowed index of Al motion, as opposed to the proportion of WIP >100 which had a negative index and allowed Al to move. Based on the results, the recommendations are summarized to install a meteorological station to monitor climate change and to take samples of surface runoff during the period of flash flood, while maintaining flow data for continuous periods to monitor erosion and sediment transport in the valley and to collect rainwater to measure rainfall quantities and analyze its chemical and physical properties. In addition to taking samples of sediments for a longer period along the valley to determine its characteristics and modes of movement.

المصدر الجيوكيميائي للصخور الرسوبية الكلاستيكة حالة الدراسة : وادي الغار

اعداد: ضحى محمود محمد عواد

اشراف: د. جواد شقير

الملخص:

تعتبر الصخور الرسوبية سجلاً تاريخيًا للظروف المختلفة التي تمر عبر المنطقة ويمكن استنتاج تكوينها من تطور المنشأ والإطار التكتوني. تتأثر الصخور الرسوبية بالعديد من العوامل التي تخلق رواسب مثل الطقس الكيميائي والمناخ والنقل. لفهم وتعريف بيئة الترسيب ومصادره ، من المهم دراسة الخصائص الجيوكيميائية. الغرض من هذه الدراسة هو مراقبة حركة الرواسب من منطقة إلى أخرى بسبب عمليات الجريان السطحي في منطقة وادي الغار و كمية الأمطار التي تسقط على المنطقة. أجريت هذه الدراسة بتقدير كميات الأمطار ثم دراسة الخواص الكيميائية والفيزيائية للرواسب المتحركة. حيث تعرضت منطقة وادي الغار لفيضانات عميقة من المناطق المحيطة بها ، وتفاوتت منطقة الدراسة في الارتفاع في نطاق 400-1000 متر ، وكان المنحدر للمياه الجارية 0.02 . تؤثر هذه الفيضانات على التكوين الجيولوجي وترتيب الكثبان الرملية ، وهي في الأساس رواسب تنتقل من المنبع إلى المصب.أما بالنسبة لمنهجية البحث ، تم جمع 48 عينة من الرواسب والجريان السطحي خلال عامين (2017-2018). كانت عملية جمع العينات على مرحلتين حسب الموسم الرطب للمناخ الفلسطيني (أبريل - مايو) وموسم الجفاف (أكتوبر - نوفمبر). تم تحديد نقطة العينات (X،Y، Z) على ارتفاعات مختلفة في العمق ، حيث أخذت عينات من الرواسب على طول مجرى القناة أكثر من مرة لمقارنة النتائج مع بعضها البعض. تم تقسيم الدراسة إلى عدة أقسام: كميات (هطول) هطول الأمطار ، الخصائص الكيميائية والفيزيائية للرواسب المتحركة ، عنصر الأرض النادرة ، النظائر (δO18 ، δC13) ، الكربون العضوي والنتروجين الكلي لكل من الرواسب والجريان السطحي.

أوضحت النتائج أن الوادي ينقسم إلى خمس مناطق بناءً على الأسماء المستخدمة في تلك المنطقة: معزة ، أم جريش ، عرب رشيدة ، وادي المصيدة ، مفرق الواديين و Downstream. بناءً على الطبقات الجيولوجية المتكشفة في منطقة الدراسة و اعتمادًا على العصور التي تكونت فيها ، تتشابه الصخور الرسوبية في منطقة الدراسة مع جزء من الصخور الرسوبية التي تشكلت في أواخر العصر الطباشيري ، وخاصة العصر السينوماني والتوروني. والتي تغطي جبال الخليل، وهذا يشير إلى عوامل الانجراف التي تعرضت لها، والتي

أدت إلى انتقالها من خلال الجريان السطحي ثم ترسبها على شكل كثبان رسوبية في وادي الغار. علاوة على ذلك ؛ أظهرت النتائج أن الرواسب في الوقت الحالي تتحرك في نفس المنطقة ، وأن جزءًا صغيرًا فقط ينتقل إلى المناطق الوسطى بسبب التأثيرات المحيطة. يتم إنتقالها من خلال عوامل التآكل المختلف كالمنحدر ، تكوين التربة ، الصخور، الشكل الجيولوجي والظروف البيئية الصعبة التي تتعرض لها المنطقة. كما كانت نتائج عناصر النزرة والعناصر الرئيسية تؤكد على أن نوع الرواسب الموجود هو دولومايت والذي يحتوي على نسبة عالية من العناصر التالية (Ca, Mg, K, Na)،بينما كانت نتائج REE قليلة جداً <0.01 تم ايعاز ذلك الى عدم مقدرة نقل العناصر بالجريان السطحي وعدم وجود مصدر لارتفاع نسبها في الكتل الرسوبية. كما أكدت كل من النظائر δO18 (4.17- _2.97-)، δC13 (2.97- _6.24-) على وجود الحجر الجيري في الرواسب. على اية حال كانت قيم الكربون العضوي والغير عضوي والنيتروجين الكلي تختلف بين العينات التي أخذت وذلك بسبب اختلاف المصادر وتنوعها. ومع ذلك ، كان من المهم دراسة عوامل التجوية على الرواسب لفهم تأثيرها، فقد لوحظ أن نسبة CIW و PIW لها مؤشر إيجابي وغير مسموح به لحركة Al ، مقابل نسبة WIP < 100التي لها مؤشر سلبي وتسمح لـ Al بالتنقل. وبناءً على النتائج تتلخص التوصيات بتركيب محطة للأرصاد الجوية لرصد تغير المناخ وأخذ عينات الجريان السطحي خلال فترة الفيضان المفاجئ مع الحفاظ على بيانات التدفق لفترات متواصلة لرصد التآكل وعمليات نقل الرواسب في الوادي وجمع مياه الأمطار لقياس كميات الأمطار و تحليل خصائصها الكيميائية والفيزيائية. بالإضافة إلى أخذ عينات من الرواسب لفترة أطول على طول الوادي لتحديد خصائصه وطرق حركته.

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Abbreviations

REE	Rare Earth Elements
HCO_3	Bicarbonate
d13C	Stable isotopes Carbon-13
d18O	Stable isotopes oxygen-18
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
OM	Organic Matter
SOP	Standard operating procedure
TNb	Total Nitrogen bound
TOC	Total Organic Carbon
TIC	Total Inorganic Carbon
ARV	Annual Runoff Volume (m^3)
MAR	mean annual runoff (mm)
MAP	mean annual precipitation
A	catchment area (km^2)
K	runoff coefficient
WIP	Weathering Index of Parker
CIW	Chemical Index of Weathering
PIA	Plagioclase Index of Alteration
CIA	Chemical Index of Alteration
GIS	Geographic Information System
GPS	Global Positioning System

Units

%	Percentage
µg/g	Microgram/gram
cm	Centimetre
M	Meter
Km	Kilometre
km^2	Square kilometre
meq/l	Mille equivalents of solute per litre
mg/l	Milligram/liter
mg/kg	Milligram/Kilogram
µS/cm	Microsiemens/Centimetre
mm	Millimetre
ppm	Part per million
°C	Celsius degree
Ft/sec	Feet/ second

Chapter one

1.1 Introduction

Sedimentation could be generally defined as processes letting suspended materials (including soil, organic materials and particles such as clay or silts) settle by gravity to create what called "sediments". Specifically, sediment defined as materials deposited by gravity from rivers or sea waters, and consisting of particles coming from the alteration of other rocks (Choden et al.,2009). In Latin words sediments “sedimentum” defined as material that settled down from a muddy suspension. In the other hand the term of sedimentum include the hard part of organism that deposit or deposition of chemicals (Iannace et al., 2009).

Sediment formed when solid particles (composed of compressed organic matter consists of fragments of rocks and minerals) carried out by rivers, oceans, winds and rain runoff force, and when the transportation energy lay down and become not strong enough to carry these particles, they drop out in the process of sedimentation which called clastic sedimentation which leads you form what called sedimentary rocks. Sedimentary deposition may occur in another different ways, when the materials of sediment are dissolved in water and chemically precipitate, this sedimentation process called chemical sedimentation, while biochemical sedimentation takes place when the living organisms in water extract the ions to form things like shells and bones, the last type of sedimentation happened when plant matter accumulated and called organic sedimentation where chemical and organic residues consist of the remains of organisms when they are die (Pant et al.,2010).

Accordingly, Sedimentary rocks are consisting of deposited mineral grains and natural rocky from a fluid phase through physical, chemical, biochemical or organic processes, these processes occur by topographic effect commonly in sea, river and oceans called "sedimentary basins” (Iannace et al.,2009). Magmatic and metamorphic rocks had been formed through endogenic processes which is energy is produced by energy intensity, temperature, earthquakes and volcanoes known as the phenomenon of tectonic setting, which is the energy emitted from the inside of the earth affect the tides, rotation and friction from the ground, this energy controls the earth's crust tectonically. Sedimentary rock is the basic component of earth surface formed by exogenic processes (Iannace et al.,2009). Where it represent the processes that originate externally on the surface of the earth from external processes and geological processes, which are essential processes in the formation of terrain, and they are linked in the hydrosphere and the atmosphere, and therefore by weathering, erosion, transport, sedimentation, erosion, etc (Graniczny 2006).

Sedimentary rocks could be classified to several types, the most important types are: (1) Biochemical limestone rocks where the calcite is formed from the outer membrane or skeleton of living organisms and, accumulated to form limestone such as gems where calcite is a mineral found in most types of rocks, it consists of calcium carbonate ($CaCO_3$). While limestone, it is a type of sedimentary rock that contains 50% calcites associated with another type of mineral. (2) Biochemical chert in which silica accumulates at the bottom of the sea and crystallizes to form a biochemical chert. Solid rocks have been crystallized**,** (3) Diatomite which formed in the absence of crystallization, where diatoms accumulated to form white rocks (4) and Coal rocks where the fossilized organic matter is formed from organic carbon and then accumulates in the humid tropical wetlands and requires the absence of oxygen (Pant et al.,2010).

According to their physical and chemical characterizations, sediments could be classified into two main types: (i) Silicalclastic sediments and (ii) Chemical / Biochemical sediments. Silicalclastic sediments are composed of compressed materials including silicate minerals like quartz and feldspar and rock fragments (clastic), where the chemical and physical geological effects leading to breakdown the rocks and to create sediments that play a major role in the formation of the origin of limestone. Silicaclastic sediments that resulted formed explosive volcanism products are called volcaniclastic rocks. The silica deposits include various types of rocks such as limestone, kernels and evaporation such as gypsum, phosphorites and iron-rich sedimentary rocks. On the other hand, carbon rocks which contain 15% of animal and plant residues, which are considered as organic matter, although they form a small percentage of sedimentary rocks, it has an important economic role such as fossil fuels (Langland et al., 2003).

Depending on their components, sediments can be divided into two parts: (1) Strong section travels at the bottom of the gulf or river and this type has a little impact on penetration of light, and (2) fine granules that remain attached to water, this type can affect the penetration of light due to the quantity collected and called total suspended solid (TSS) (Langland et al., 2003).

1.2 Transported sediments (Bed load, suspended and wash load)

Soil erosion and sediment transfer are generally takes place through two natural processes that occur based on the morphology of the region. These processes are balanced based on soil composition rates, where sediments play an important role in conserving river environments, the balance of the natural environment can affects in the event of environmental interventions and human activities, the rate of transfer of sediments can also increase in line with the increase in the population and intensification of agriculture in the region based on studies conducted in 1900 (UNESCO 2011). Transported sediments are important elements of the global geochemical cycle, depending on the local factors of the study; it can be shown that the sediments are useful or harmful to the environment, the negative effects of increased sedimentation can lead to increased flooding and resulting property damage, water supply contamination, crop loss, displacement and sometimes loss of life. Sediment transport is one of the important natural geochemical cycles and the transport of organic matter from the Earth to the oceans. Natural river tributaries remain in a morphological equilibrium where sediments flow at an average rate. Sediment can be disturbed by slowing or stopping water, thus preventing sediment transport. The climate mainly affects sediments so that it could be increased or decreased by climate change in terms of rainfall and runoff. Human factors such as agricultural production can also affect sediments by interacting with the climate. It is very difficult to control the management of sediments because each topographical character for each topographic environment is different from the other. Sediments can be controlled by studying the morphology of the area and conserving water, soil, wood cover and riparian land, so that misbehaving such as deforestation may lead to increased sediments (UNESCO 2011).

Transport of sediment done by three major ways :(1) Bed load transport, (2) suspended-load transport or as (3) dissolved-load transport or wash load (Hickin et al., 2004).

Bed load refers to the fine grains that moves along the bed of a flow, the fine grain consisting that material in particular that rolling and sliding by the flow, where suspended sediment load formed from compressed fine material that carried in suspension load and wash load which are finer compressed but larger than the suspended load and moving through water (UNESCO 2011). This type of material is usually sand and gravels (Hickin et al., 2004).

Suspended sediments are mainly affected by the force of flow and turbulence which elevate the concentration and produce coarser material. Suspended load constitute approximately 90% of transported sediment. The difference between suspended load and wash load that the wash load does not depend on the turbulence force, it can stand for long time in the suspension by the force of turbulence associated with molecule agitation of the water (Hickin et al., 2004).

1.3 Sediment Provenance:

The term Provenance includes all the conditions to which sediments have been exposed to its production, in addition to the geological sciences whose jurisdiction includes studying the location and nature of areas of sediment sources and the paths through which sediments are transferred from the source to the sedimentation basin, and the factors that affect Formation of sedimentary rocks (eg relief, climate, tectonic environment). Source data helps to understand and evaluate the evaluation of old reconstructions, forecasting reservoir quality, subsurface bonding, sedimentation system mapping, and crust identification that is no longer exposed, and ultimately, the evolution of the Earth's crust (Haughton 1991) (Mazumder 2017)

1.4 Sediment storage:

As a result of soil erosion and the transfer of sediments from one place to another new layers have been produced in the place transferred to them, such as: (1) Rhythmic Layering which is composed of soft and rough parallel layers formed through the different seasons. (2) Cross Bedding is another type of layers that consist of a group of sediments associated by moving path or wind, the boundary between each layer represents the surface of the corrosion. (3) Graded bedding in which, the crust of water formed after a strong flow produces three types of dense sediments and then small particles followed by low density deposits that deposited on the density and low-density deposits remain stuck called turbines. (4) Non-sorted Sediment which consists of a mixture of different sediments of different sizes such as rocks and mud.(5) Ripple Marks**,** it consists of sand dunes and sedimentary rocks. (6) Mud cracks which resulted from the drying of the sediments on the ground which is considered as an indication of the level of the earth's surface. (7) Sole Marks they are soft deposits filled with mud. (8) Raindrop Marks resulting from the fall of rain, an indication of detection before burial and (9) Fossils which is one of the most important signs of sedimentation since it is formed from the remains of living organisms (Pant et al., 2010).

1.5 Tectonic setting:

The transport of sediments and their quantities are affected by a phenomenon which affects all processes of moving, lifting and building parts of the earth's crust. They include the following operations: (1) Organic which involve long and narrow straps of the crust due to extreme pressure resulting in significant deformation, (2) Epeirogenic processes Include alteration, distortion or lifting in large parts of the crust resulting in a simple deformation, (3) Earthquakes Affect the earth's crust by making small changes by small local transports, (4) plate tectonics works to move the plates horizontally, affecting the shape of the crust, (5).Earthquakes and plate tectonics cracking results in significant deformation of the earth's crust.

All these phenomena clearly affect the temperature, volume and pressure intensity, which causes the rocks to transformation (Pidwirny et al., 1996).It also helps to classifying clastic sediment etc.

1.6 Factor affecting sediment transport:

The transport of sediments is affected by several factors that increase or decrease sediment transport from these factors: rain, soil forming, vegetation, and wind, geological formation of the area, climatic factors, and runoff and flow rate.

Flow strength mainly affects the transfer of sediments by rain water in the form of surface runoff, where the sediments momentum are affected by gravity, the amount of flow and the momentum of sediments and strength of the resistance of the bonds which cause disturbances on the surface of the water causing cracks or resistance in the form of clouds. Factors affecting the force of vegetation flow are water-resistant forces in addition to suspended sediments (Miller et al., 2007). As well, the flow and sediment transfer are affected by the properties of sediments which known as gluten system that works on the conglomerate of suspended matter and depositing it to be different from its initial properties. However, it is also affected by the traction forces and the friction force between the flows. However, it is also affected by the traction forces and the friction force between the fluxes and the flow resistance forces associated with the roughness of the channel. On the other hand, the flow is resisted by the roughness of the grain and its shape changes, where grain roughness occurs due to the traction caused by sediment, plants...etc. An important factor influencing the transmission of sediments is the drainage method, which works to increase the erosion of the soil significantly, coincides with the height of the basin and the strength of flow and morphological nature of the path in which drift occurs. Sediment rates are also affected by temperature, since the previous studies have shown that cold areas have the lowest rates of sediment transport, unlike hot regions. Nonetheless, the harmful environment that human can cause as destruction of crops, land use changes and harmful industries increases soil erosion significantly (Hassanzadeh et al., 2012).

Additional impacts that can affect sediments are the organic matter in the transferred sediments. In addition, it adds important explanations for the environmental changes caused by humans. The concentration of organic carbon on the quantities of organic matter is therefore integrated with other materials to affect organic matter, delivery routes, depositional processes, and amount of conservation. (Meyers et al., 2002)

1.7 Geological Formation:

Wadi Al-Ghar has a distinctive geological formation, with more than one formation like: Abu dies formation, Jerusalem formation, Hebron formation, Bait kahel formation. (Figure 1.1)

- Abu dies formation: Formed in the canonical age, its thickness ranges from 58 m - 175 m. It spreads in the eastern areas to Jerusalem, but in the west it is uncliff (As a result of the acquisition of tectonic transports and change in sea level, there is a phenomenon of so-called slopes, and influenced by several influences, including: (1) topography of the region,(2) rock resistance, the effects of coastal operations, the transport of waves. Including stable and vulnerable to collapse. Cliffs are also affected by erosion formation and therefore difficult to see (Pidwirny 1996). Its main component is two layers of chalk and a layer of chert. This formation is aquiclude (Some rock types act to store water and prevent groundwater transport, acting as a water reservoir. It is a type of rock or sediment that has little permeability or deposits such as oil rock or clay (occurrence of groundwater, chapter 1 page (1-79)). (Abed et al 1999).

- Jerusalem formation: Formed in the Turonian period, its thickness ranges from 70 m-130 m. It spreads in the mountains of Palestine and the north. Its main component is soft limestone, very hard and chalk layers, its aquifer (Abed et al. 1999).

- Hebron formation: Formed in the Cinomanian period, ranging from 106 m to 250 m, is distributed in more than one area in the mountains of Jerusalem, Hebron and northern Palestine. Its main component is limestone and dolomite, its aquifer (Abed et al. 1999).

- Bait Kahel Formation (upper Bait Kahel): It is spread in the northern and central parts of the West Bank, and formed in the Cinomanian period and part of it in the Albian age. It is composed of marl and chalk rocks. Its aquiclude (Abed et al. 1999).

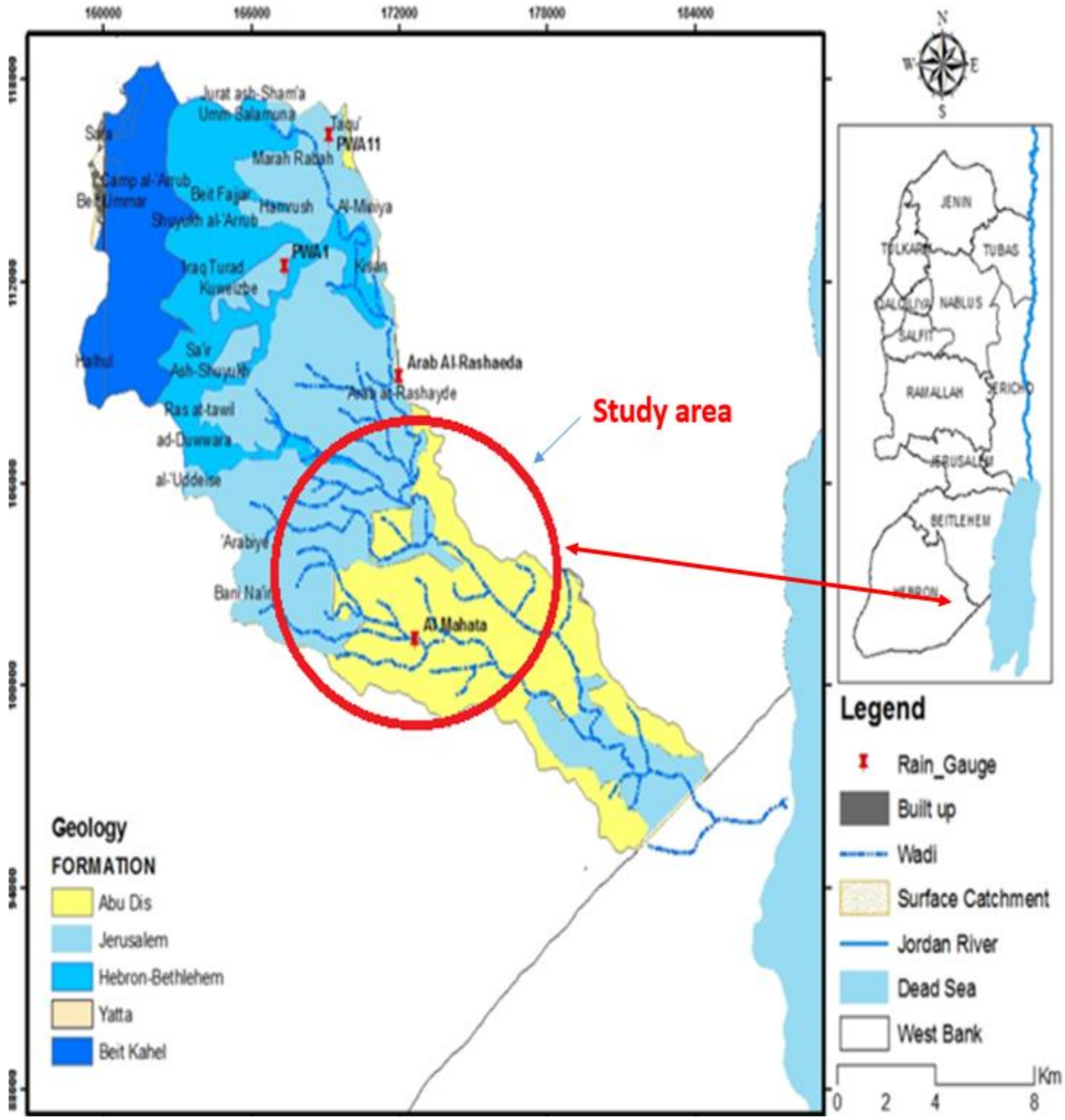


Figure 1.1: the attached map shows the different and diverse geological formation in the study area (in the circle). This map was created by GIS Lab/Al-Quds University/Husam Utair

Geological Time Scale				Group		Formation		Lithology	Thickness (m)	Hydrostatigraphy
Era	System		Epoch	Palestinian	Israeli	Palestinian	Israeli			
CENOZOIC	Quaternary		Holocene	Recent	Kurkar	Alluvium	Alluvium	Marl, alluvium, gravel	Variable	Aquifer
						Gravel	River gravel			Aquifer
			Pleistocene	Lisan	Dead Sea	Lisan	Lisan	Thinly laminated marl with gypsum bands	200+	
	Tertiary	Neogene	Pliocene-Miocene	Beida / Jenin Sub Series	Saqia	Beida	Bit Nir and Ziglag	conglomerate	0-200	Aquifer
		Paleogene	Eocene	Belqa / Jenin Sub Series	Avidat	Reef nummulitic limestone	Zor'a	Reef limestone, bedded limestone, chalk with limestone undifferentiated	100-500	Aquifer in limestone and aquiclude in chalk
			Paleocene		Mount Scopus	Nummulitic limestone	Taqiya	Marl, chalk and clay		Aquiclude
MESOZOIC	Cretaceous	Senonian	Mastrichtian			Khan Al Ahmar and Zerqa	Ghareb	Yellowish chalk		Aquiclude
			Campanian			Amman and Abu Dis	Mishash	Chalk with back chert		Aquiclude
			Santonian				Menuha	Chalk		Aquiclude
			Turonian	Ajlun	Judea	Jerusalem	Bina	Limestone and dolomite (karstic).	90-120	Aquifer
			Cenomanian			Bethlehem	Weradim	Hard gray porous dolomite	90-100	Aquifer
							Kfar Shaul	Chalky limestone, chalk and marl	30-40	Aquitard
						Hebron	Aminadav	Karstic limestone and dolomite	110-140	Aquifer
						Yatta	Moza	Marl, clay and marly limestone	10-20	Aquiclude
							Beit Meir	Limestone, chalky limestone and dolomite	120-140	Aquifer
								Limestone inter -bedded with marl		Aquiclude
			Albian			Upper Beit Kahil	Kesalon	Limestone inter-bedded with marl	30-50	Aquifer
							Soreq	Dolomite inter-bedded with marl	110-170	Aquifer
						Lower Beit Kahil	Giva't Yearim	Limestone, dolomite	20-70	Aquifer
							Kefira	Limestone, dolomite and marly limestone	120-180	Aquifer
				Kurnub		Kobar	Qatana	Marl and clay	50	Aquitard
							Ein Qinyia	Marl and marly limestone	60-70	Aquitard
							Tammun	Caly and marl	80-150	Aquitard
			Aptian				Ein Al Asad	Limestone		Aquifer
					Kurnub		Nabi Said	Limestone		Aquifer
			Neocomian			Ramali	Hatira	Sandstone	150	Aquifer
	Jurassic		Callovian-Bajocian	Zerqa	'Arad	Upper Malih	Upper Malih	Marl interbedded with chalky limestone	190	Aquitard
						Lower Malih	Lower Malih	Dolomitic limestone, jointed and karstic	55	Aquifer

(Table 1.1: Generalized stratigraphic column of the West Bank (after: Guttman et al., 2000 and Geological Survey of Israel, 1990-2002).)

In the above table (table 1.1) it shows the distribution of general rock planning for the West Bank rocks that build the aquifers in the study area, where the rocks are divided into two triple and chalky types which consist of limestone, dolomite, chalk and marble with gangs of flint. It happens that it was formed in the Tertiary and Cretaceous age. These rocks formed groundwater reservoirs in the West Bank, the Genomanian-Toroni (upper) reservoir in the formations of Jerusalem, Bethlehem, Hebron, and Albanian underground.

(Lower) in the formations of Beit Kahil, upper and lower, and the separation between clay and wombs is in the formation of Yatta groundwater. Yatta formation is the main water part of the West Bank. The earliest exposed rocks belong to the dairy, and are covered by smaller layers of Cenomanian, Turonian, Senonian and Eocene, exposed on both sides of the pivot wing in the West Bank. The exposed rocks in the West Bank are divided into three types, which are: A) Lower Cretaceous (Albanian) formations that include the groundwater network in the West Bank (Beit Kahil, Yatta formations), where the thickness of the groundwater system in this area ranges between 500-970 meters. B) The upper Cretaceous formations consist of the regional groundwater system in the West Bank (the Hebron, Bethlehem and Jerusalem formations), while the thickness of the groundwater system in this area ranges between 190-490 AD. C) The stony rocks (the formation of Abu Yamout) are mainly chalk and molluscs and their thickness ranges between 0-450 m (Hasan 2009).

1.8 Problem statement:

Wadi al-Ghar is characterized by a steep slope (0.02) where wadi has an estimated area of about 250 km^2 and its height ranges from 1000-400 meters above sea level compared to the surrounding areas, which are the villages of Hebron. This makes it a stream that transports runoff from the neighboring areas with high precipitation rates (≈500mm) until it reaches the Dead Sea. This process affected the geological form of the region and could affect the tectonic setting and increasing sediment rate in the Dead Sea due to erosion processes that led to the transfer of sediments and their accumulation in the form of sedimentary masses in the wadi. Among the factors that also helped in weathering, are the lack of rain and the lack of vegetation, in addition to considering it a wild area and the construction is not appropriate in it. In addition to the decrease in the rate of infiltration into topsoil, which led to the non-consumption of surface runoff and its transfer to springs to recharge the groundwater, Geological Formation is characterized in the wadi as a water reservoir and reaches the groundwater that feeds Al-Fashkhah springs.

1.9 Research goal:

Determining the origin of sediments transported through surface runoff by studying the physical and chemical properties, including trace elements, major elements, rare earth elements, and oxygen and carbon isotopes. Then performing quantitative calculations of the results and trying to understand the origin of the sediments and the factors that influenced their transmission include weather and structural formation for the wadi. This transportof sediments, in turn, was the reason for changing geological standards and behaviors on the surfaces that directly affected the recharge of groundwater and springs around the Dead Sea, including the Fashkha springs, but unfortunately, the Palestinians do not benefit from them, as they only consume 11% of spring water. In addition to increasing consumption from the Israeli side, it leads to a decrease in the level of the Dead Sea water due to the lack of adequate quantities of runoff.

1.10 Research Objective:

1- Study the sediments deposited in wadi Al Ghar, monitor their sedimentation methods and the layers that resulted, and try to understand the transport process that affected them.
2- Study Factors affecting the transport of sediment along the stream of the wadi.
3- Study the geological formation of the area and its effect on sediment transport, sedimentation and layer formation, then observing the effect of sediment transport on the geological formation of the region after sedimentation.

1.11 Research Justification:

The quantities of surface runoff to which wadi Al-Ghar is exposed are very large, and due to the increase in the factors affecting the boundaries of the erosion processes, the sediments are moved and deposited in new masses. Which leads to a change in the geological formation and possibility of moving to the Dead Sea. So it is necessary to study its characteristics, its origin, and its transport cycle.

1.12 Research question:

1- How can the chemical and physical properties of the sediments be used as traces of their Provenance and transport?
2- Can carbon and oxygen isotopes be used to determine the sediment origins?
3- How does the process of erosion occur in sedimentary rocks, how does it moved and how is it impacted the arrangement in beds?

Chapter Two

Literature review

The theories of scientists in many studies have helped to approach the thesis of sediment origin, morphology and sediment studies, trying to understanding sediment moving process. Some of them studied the chemical properties (Trace element, REE, Major element) of the sediments and the other studied the isotopes ($\delta^{18}O$, $\delta^{13}C$), while others studied the organic materials (TOC, TNb, TC) and others studied the physical properties of the sediment (Texture, fine grains, pH, EC),in order to try to get a clear answer to the strange component.

Determination of the origin of the transferred sediments and their modes of transport is very important in determining the geological characteristics of the study area. A number of scientists have studied sediments in different ways. Where (Rudolf Jaffé 2001) was found that the best way to study sediments is to determine their properties, and study organic matter in addition to the study of biomass and vegetation. (Pant 2010) confirm that where he studied Characteristics of 35 sediment sample by analysis using ICP-AES for major elements (i.e. Al, Ca, Fe, K, Ti, Mg and Na) and trace elements (e.g. Ba,Co, Cr, Cu, Ga, Ni, P and V), both major and trace elements provide important information for silica deposits of sediment origins, conservation and recycling methods, and hydraulic sorting. Also (Peterson 2009) using the geochemical properties of the sedimentary rocks to understand the previous geological history of the region as well as determine the sedimentation and origin of the existing sediments. (Peterson 2009) assert in his study that the best way to determination provenance of transported sediment by analysis major and trace element compositions of the sediment samples

Otherwise (Schwamborn et al 2002) He had a different opinion, he study the sediment properties by Observe (heavy mineral composition, grain size characteristics, organic carbon content) to analyse the construction of historical deposition. (Zaaboub et al 2015) Agree with the former he study the properties of the sediment deposits for 45 sediment samples by using X-ray and the study of concentrations of the most materials in addition to the study of organic carbon. Unlike other researchers (Schneider et al 2015) was interested in studying the transferred sediments and the factors that affect their transport from the wind to the flow of water speed and strength of the flow. Research methods were dependent on Study of the roughness of the flow and monitoring the survey of the land and study the size of sediments as well as the study of land gradients with consideration the speed of flow. Also consider how low flow power can be achieved at steep slopes.

On the other hand, scientists are interested in studying the natural phenomena, climate and rainfall in the region in order to predict the possible floods that could lead to hurricanes affected by the Mediterranean climate that could be harmful to the environment and humans.

(Ahlborn et al .2017) confirms the arrival of the sediment and its transfer to the Dead Sea because of the slopes of three main areas (Arugot (wadi al-Ghar), David(wadi dauod), and Hever(Naqab)), where they found that through the study of thin sections of the sediments that they moved to the Dead Sea due to heavy rainfall, and control the characteristics of sedimentary layers and soil types and texture. They then considered that the new flow quantities as evidence and indicator of the intensity of precipitation flowing to the region and study the previous changes in the pattern of the circulation of the atmosphere. (Belachsen et al .2017) followed the same approach as he study convective rainfall in a dry climate: relations with synoptic systems and flash-flood generation in the Dead Sea region. The main objective of the study was to determine the characteristics of the rain cells that arose in different synoptic systems in an arid climate zone and to understand the reactions of rainwater harvesting with the generation of sudden flooding. Indeed, the study showed temporal and spatial characteristics of rain cells over the dry lands of the Dead Sea, which can predict the amount of rainfall that may cause flash-floods. While (Dor et al .2018) Focused on a study Changing flood frequencies under opposing late Pleistocene eastern Mediterranean climates. Where studied sections of sediment sheets located in the Dead Sea, so that it can be guessing of the floods that occurred and deposited during wet rainy seasons. The floods were triggered by strong rainstorms in the eastern and western parts of the Dead Sea. The classification of portable coarse sediments and the control of organic matter deposited on the surface of sediments, as well as the study of the method of production of Aragonite. From this, the geological and climatic conditions of the Mediterranean region can be used to predict the levels of the Dead Sea.

However; (Armon et al .2018) also using Synoptic-Scale Control over Modern Rainfall and Flood Patterns in the Levant Dry lands with Implications for Past Climates, the study was based on two main axes:**(i)** Meteorological and hydrological data. **(ii)**Geomorphic analysis through remote sensing: Nahal HaArava (wadi alnaqab). It was concluded from this study that the factors affecting storms are as follows: **(i)** moisture sources and dynamics **(ii)** rainfall patterns **(iii)** flash flood patterns **(iiii)** geomorphic implications of flash floods. The study showed that the Synoptic rotation patterns differ in the Levant, where the moisture affects the transition to low-density rain and can form floods. As for the heat they affect the periods of increase.

(Dente et al 2017) went to another thought where he studied Geomorphic Response of a low-gradient channel to modern, progressive base-level lowering: Nahal HaArava (wadi alnaqab), the Dead Sea. The researcher found that his study area, which has changed significantly and remarkable over 35 years, has been transformed from a large and shallow area to narrow and sloping and distributed this result due to the floods that occur in the region and raise the level of the sea. Factors influencing the development of this channel include: The channel mouth slope, flood amounts, and the quality of existing sediments.

On the other hand (Hussam Utair, 2013) studies the Quantifying the Surface Water Runoff to the Dead Sea under Different Climate Scenarios, Case Study wadi Al-Ghar Catchment. There was fluctuation in rainfall and runoff in wadi Al-Ghar in the dry and wet seasons, which in years was less than 200 mm while in other years it was about 1000 mm. In 2011 the precipitation amounts averaged about 475 mm, and the flow amounts were about 132 m^3.

Chapter three

Methodology

In this Chapter, methods and practical research methods used to obtain clear explanations about the origins of sediments distributed along the wadi were explored. And in order to do this it had to be divided into several parts which are: 1) study area 2) sampling 3) Weather Properties and Precipitation Rates 4) Studying chemical and physical properties of runoff 5) Sediment Settling and Storage 6) Factors affecting the transport and arrangement of sediments 7) Observing sedimentary storage 8) Chemical analysis of sediments. Also, discuss experimental section. This content was divided into two parts, the first section was through fieldwork and during two different time periods the season (April/2017- August/2018) comparable (sampling, Sediment Settling and Storage. et al) , while the second section included a theoretical and practical analysis within the laboratory(study area, Studying chemical and physical properties of runoff. Et al).

3.1 Study Area:

The study area is located in the village of Bani Na'im wildlife, which is located in the city of Hebron; Located about 7 kilometers east of Hebron It is bordered to the east by a traveler from Bani Naim and from the west by Bethlehem. To the north are the town of Sa'ir and the town of Al-Shuyukh and from the south is the town of Yatta. Al- Ghar wadi is located in the south-south of Hebron; the wadi is characterized by high slope and low distribution of desert plants (desert nature), which contributes to the erosion of soil. The area of the wadi is about 250 km^2 with a length of 35 km (Abed et al., 1999) (Figure 3.1) The altitude of the wadi is from 400-1000 m at the meeting point of the Dead Sea which called Ein Gedi, the intensity of the decline of the wadi is 0.02 , and the area of the wadi is characterized by desert nature and does not any desert vegetables, which facilitates the erosion of soil (Abed et al., 1999).

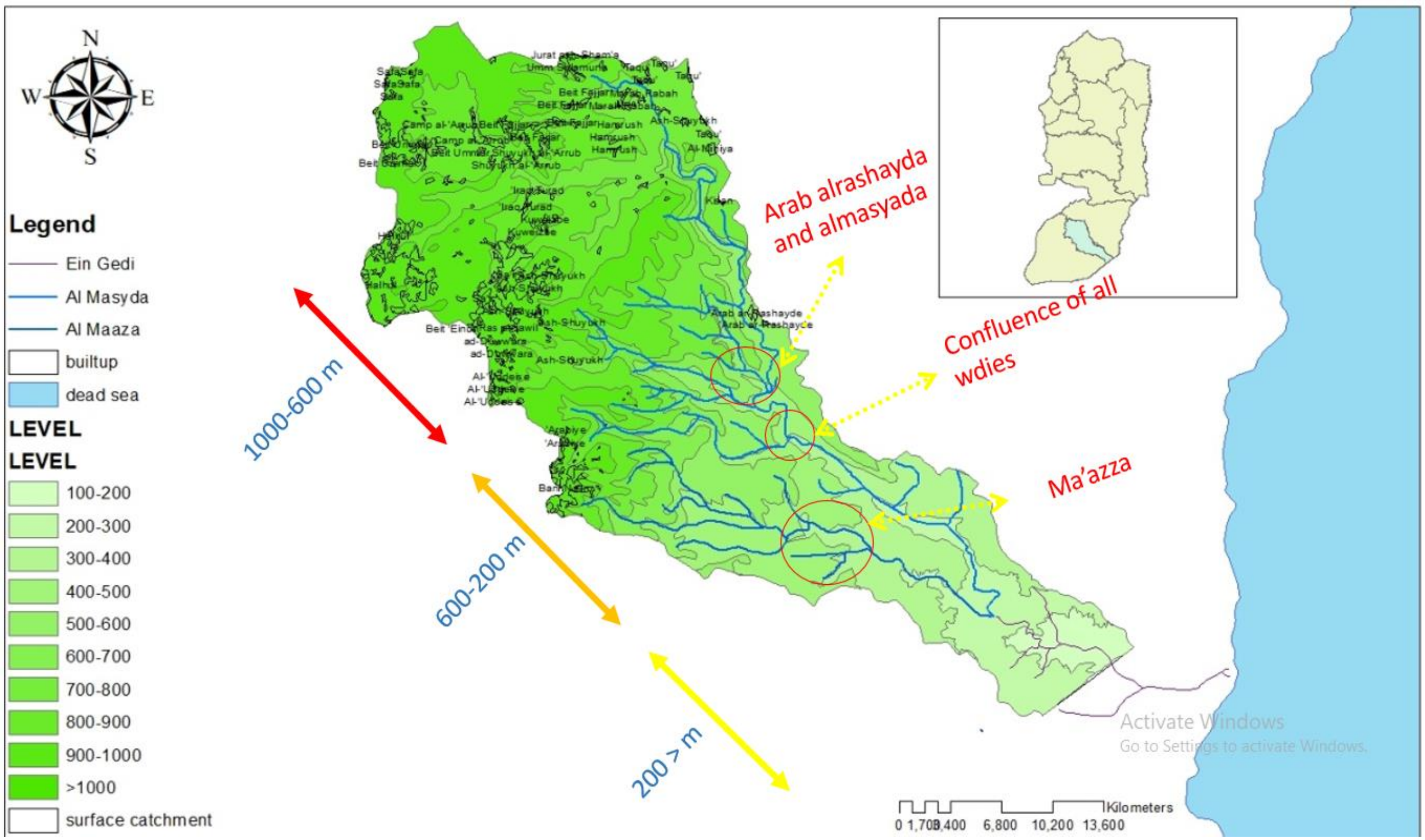


Figure 3.1: The map showed the rate of wadi Ghar's rise above sea level, and the strong decline in the valley that facilitates runoff and sediment transport through it. The map shows the locations of the taken samples, and the difference between them is shown in the height of the samples above sea level. This map was created by GIS Lab/Al-Quds University/Husam Utair

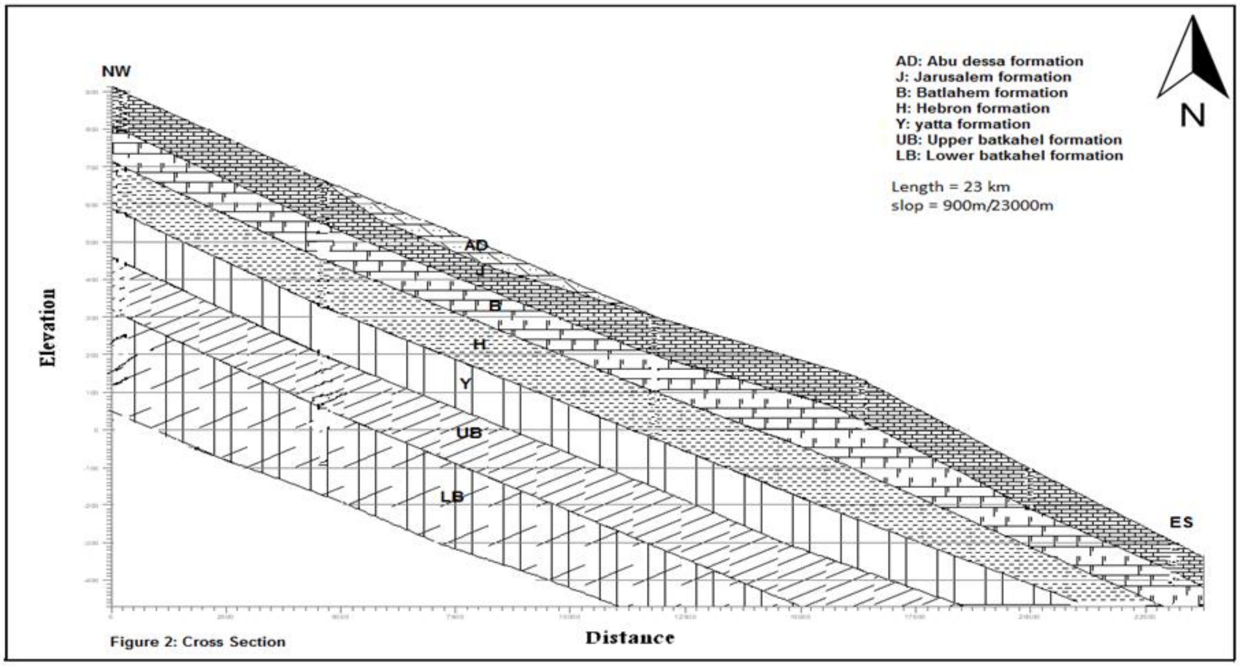


Figure 3.2: This cross-section, which represents the slope of the study area and the existing and exposed geological layers in the area, from the highest mountains of Hebron to the Dead Sea. This cross-section was created by GIS Lab/Al-Quds University/Husam Utair

Most of this area is covered by the Jerusalem layer, which consists of and is soft limestone, very hard, and chalks layers. A portion of the area is covered by the Abu Dis layer, which consists of two layers of chalk and a layer of chert which is outcrop in the middle of the wadi. Note that the y-axis represents the thickness of the existing layers, starting from the lower bait-kahel to the outcrop layer in most areas including Abu Dis and Jerusalem represented in the middle of the wadi. It also shows the rocks that make up the layers from the beginning of the wadi to a stretch of 23 km, which is represented in the form of lines.

3.2 Sampling:

Samples (sediment, runoff) were taken during two different periods (november-march/2017, April-Octoper/2018) and in two different years where the first period was in the spring and the second period in the summer a year later (August 2018) in order to monitor sedimentation and its variance. Surface runoff samples were taken from the region during three different rainy seasons, as shown in the table below. However, 4 areas were chosen for sampling along the two streams, opposite with each other, Al-Ma'azza, Al-Masyadah, Arab al Rashayda, and the Confluence of all wadies according to (table 3.1).

Table 3.1: The table below shows the locations of the sediment samples taken in the wadi with the date, height (Height of sedimentary masses above the ground), and GPS for each sample.

Sample name	**Location**	**GPS**	**Date**	**Height (cm)**
GA-UP-SS1	Al-Ma'azza	-------------------	26/04/2017	250 cm
GA-UP-SS2 a	Al-Ma'azza (Beside station)	0712567/3487622	26/04/2017	125 cm
GA-UP-SS2 b	Al-Ma'azza (Beside station)	0712566/3487622	26/04/2017	105 cm
GA-UP-SS2 c	Al-Ma'azza (Beside station)	0712567/3487630	26/04/2017	35 cm
GA-UP-SS3 a	Al-Ma'azza	0713062/3487341	26/04/2017	35 cm
GA-UP-SS3 b	Al-Ma'azza	0713062/3487337	26/04/2017	150 cm
GA-UP-SS3 c	Al-Ma'azza	0713062/3487334	26/04/2017	235 cm
GA-Up-SS3 d	Al-Ma'azza	0713062/2487338	26/04/2017	320 cm
GA-UP-SS4 a	Am Gresh	0715344/3487221	26/04/2017	100 cm
GA-UP-SS4 b	Am Gresh	0715344/3487221	26/04/2017	210 cm
GA-UP-SS4 c	Am Gresh	0715344/3487221	26/04/2017	290 cm
GA-UP-SS4 d	Am Gresh	0715344/3487221	26/04/2017	350 cm
GA up-SS5	Arabrashayda		23/09/2017	45 cm
GA up-SS6	wadi al masyada		23/09/2017	70 cm
GA up-SS7a	Confluence of all wdies		23/09/2017	40 cm
GA up-SS7b	Confluence of all wdies		23/09/2017	85 cm
GA up-SS7c	Confluence of all wdies		23/09/2017	117 cm

Table 3.2: runoff samples details that were taken from different places in the study area, where every sample was taken near the sediment soil sample, also it's taken in different periods around 2 years.

Sample ID	Location	Date	Flow Statue
GA-UP-L1122017	Al-Ma'azza	24/12/2017	beginning of stream
GA-UP-L2122017	Al-Ma'azza	24/12/2017	End of stream
GA-UP-L2012018	Al-Ma'azza	19/01/2018	Beginning of stream
GA-UP-L3012018	Al-Ma'azza	19/01/2018	End of stream
GA-UP-L1012018	Al-Masyada	19/01/2018	End of stream
GA-UP-L1-2604018	Am-gresh	26/04/2018	Beginning of stream
GA-UP-L2-2604018	Am-gresh	26/04/2018	End of stream
GA-UP-L3-2604018	Al-Ma'azza (beside station)	26/04/2018	In the middle of the stream
GA-UP-L4-2604018	Al-Ma'azza (beside station)	26/04/2018	End of stream
GA-UP-L5-2604018	Al-Ma'azza (beside station)	26/04/2018	Beginning of stream
GA-UP-L6-2604018	Al-Ma'azza (beside station)	26/04/2018	End of stream
GA-UP-L7-2604018	Al-Ma'azza (beside station)	26/04/2018	In the middle of the stream

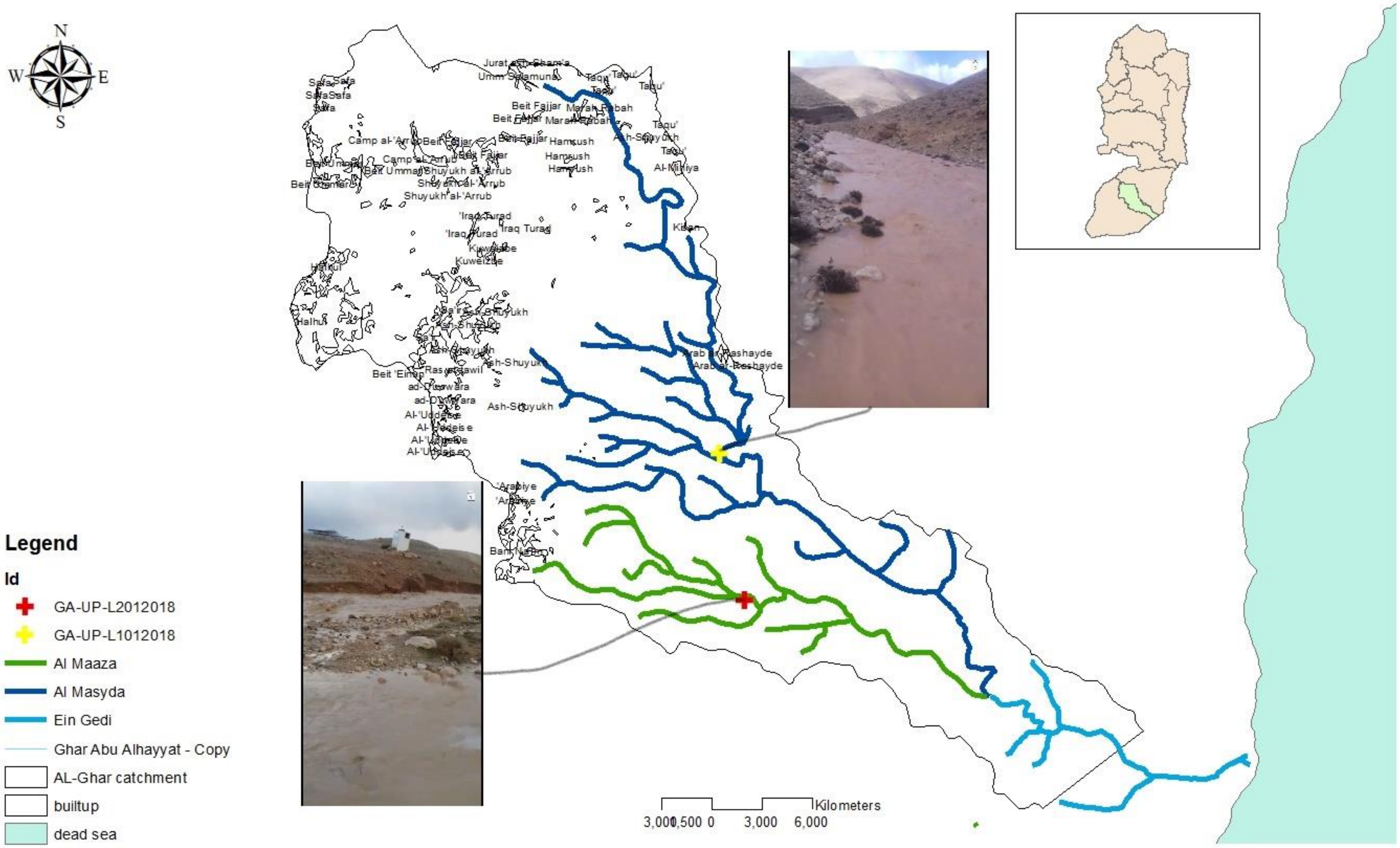


Figure 3.3: Runoff sampling location map in wadi Al-Ghar. This map was created by GIS Lab/Al-Quds University/Husam Utair

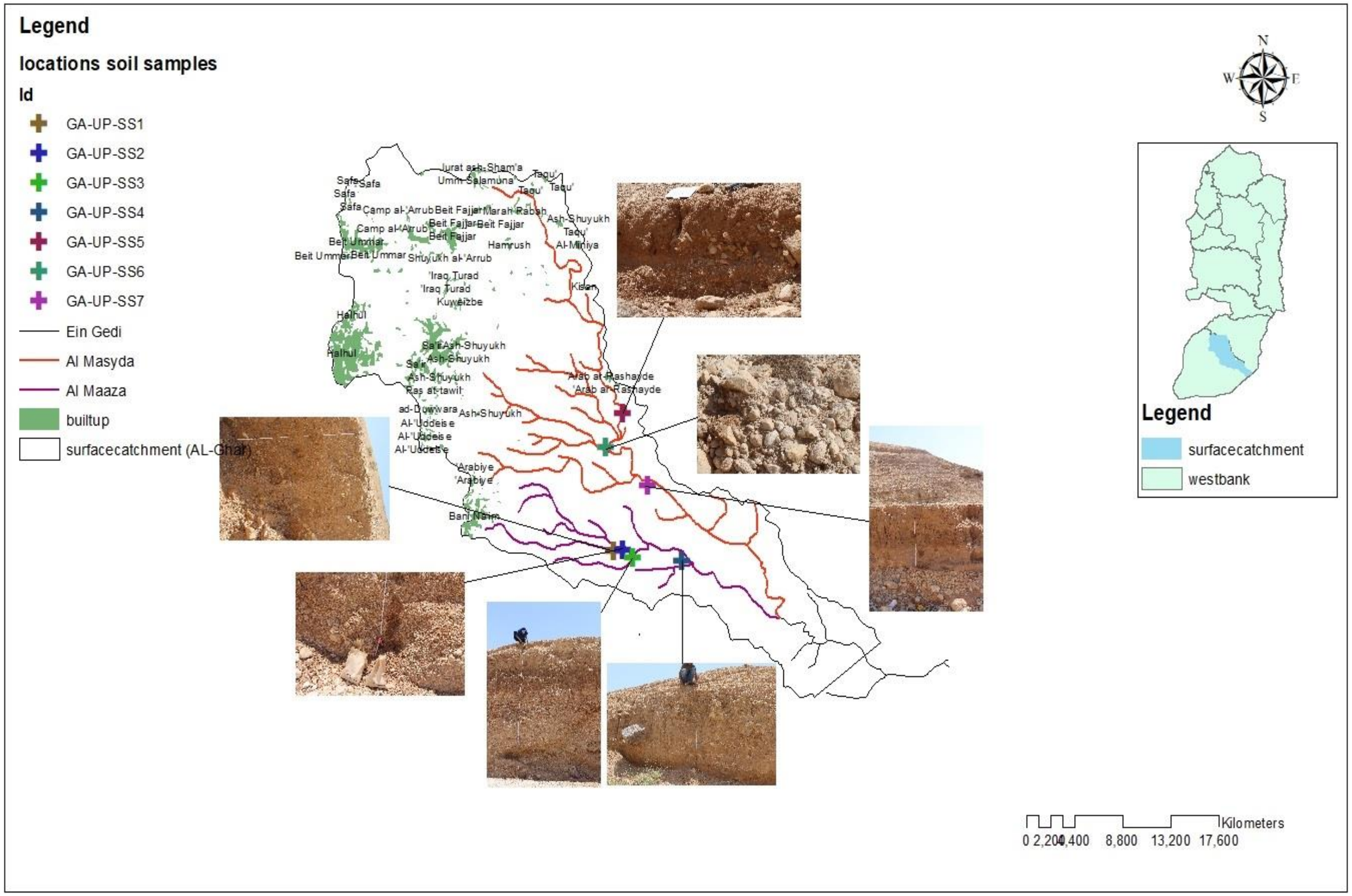


Figure 3.4: location of the samples that were taken along the wadi. Also shows the distribution of samples in the corresponding places from which they were taken. This map was created by GIS Lab/Al-Quds University/Husam Utair

3.3 Weather Properties and Precipitation Rates:

The Hebron area is characterized by a moderate climate, with hot dry in summer, cold and rainy in winter (figure 3.5) shows the distribution of rainfall in the study area according to the Palestinian climate studies the tables below show the characteristics of the climate in the Hebron area in 2014, according to the Palestinian Meteorological Department (Table 3.3). A meteorological station was installed in the study area to monitor temperatures, rainfall and runoff rates, weather impacts have an important role in the transfer of sediments from one region to another; also have an important role in influencing the hydrological characteristics and Paleohydrological and Pedagogical history.

Upstream of the wadi is subjected to shallow runoff from surrounding areas due to its slope, note that the wadi has less than 100 mm of precipitation.

The average temperature in the Hebron region during the winter of 2014 was about (10.1-13.6 ° C), and this works to increase the evaporation rates that rain water can be exposed to.

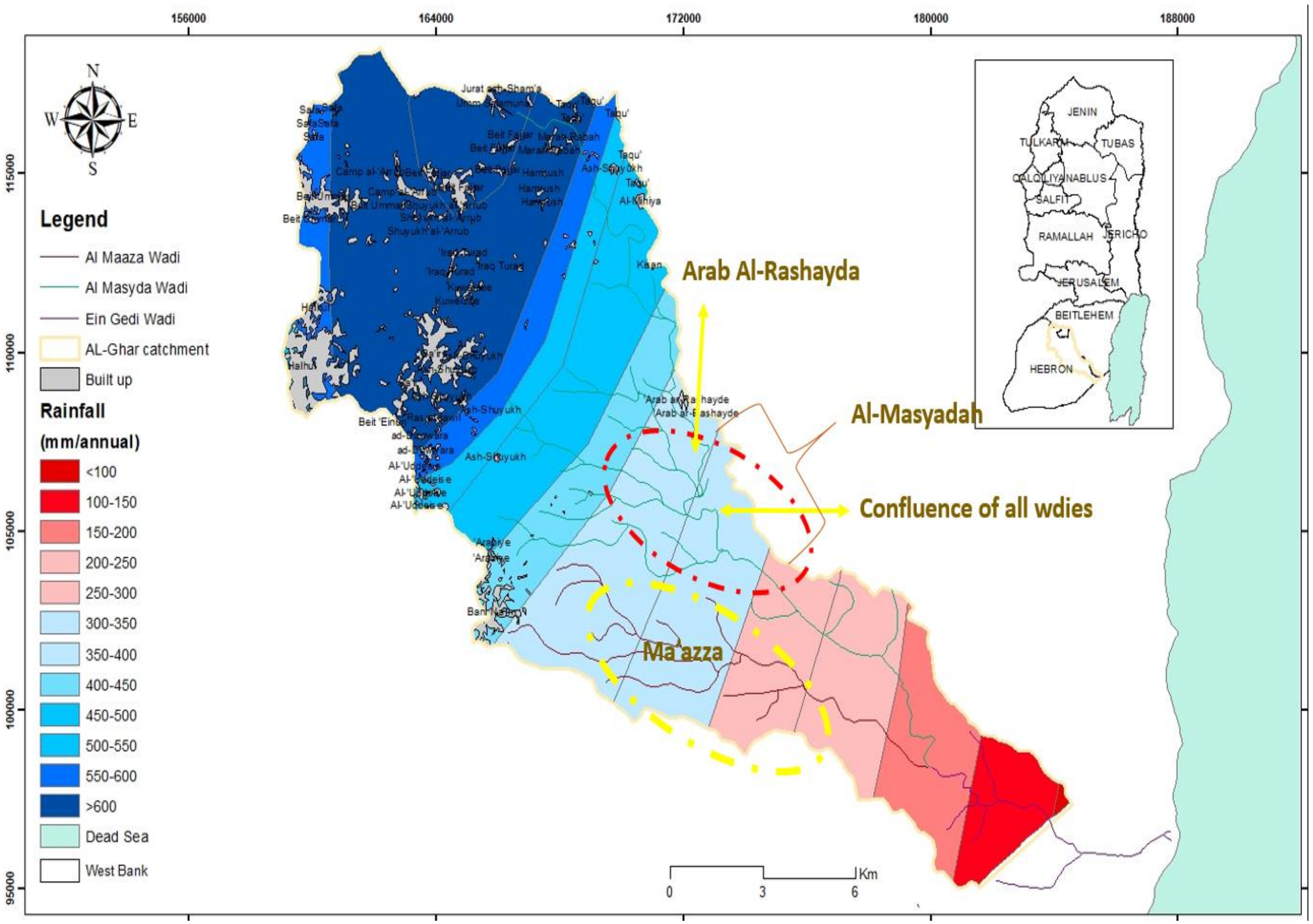


Figure 3.5: precipitation rates in wadi al-Ghar, compared to the surrounding areas, the rates of precipitation that the wadi is exposed to gradually decreased to less than 100 mm. This map was created by GIS Lab/Al-Quds University/Husam Utair.

Table 3.3: in 2014, the Palestinian Meteorological Station presented the climatic characteristics of the entire Hebron region, as shown in the annex. it shows the weather conditions that affect the areas surrounding the wadi.

Station	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Av.	Max.	Min.
Mean Monthly Temperature © for all Stations 2014 (Palestinian Meteorological Department)															
	10.1	10.4	13.6	17.4	19.2	21.4	22.3	23.4	20.5	18.0	13.2	12	16.8	23.4	10.1
Mean Monthly Wind Speed (Knots) for all Stations 2014 (Palestinian Meteorological Department)															
	4.0	4.4	4.8	4.6	4.7	5.1	5.2	4.7	4.9	4.3	5.1	3.2	4.6	5.2	3.2
Mean Monthly Pressure at Stations Level (mbar) 2014 (Palestinian Meteorological Department)															
	898.5	897.7	895.6	896.7	897.6	896.1	895.1	894.6	898.8	900.9	901.4	902.5	898.0	902.5	894.6
Mean Monthly Sunshine Duration (h/day) for all Stations 2014 (Palestinian Meteorological Department)															
	898.5	897.7	895.6	896.7	897.6	896.1	895.1	894.6	898.8	900.9	901.4	902.5	898.0	902.5	894.6
Mean Monthly Relative Humidity (%) for All Stations 2014 (Palestinian Meteorological Department)															
	66.5	65.9	60.2	47.9	53.8	56.8	61.8	61.8	77.3	73.6	75.1	75.7	64.7	77.3	47.9
Total Monthly Rainfall (mm) for all Stations 2014 (Palestinian Meteorological Department)															
	5.3	6.9	118.4	0	28.8	0	0	0	0	41.3	151.1	27	378.8		
Mean Monthly Evaporation for All Stations (mm) 2014 (Palestinian Meteorological Department)															
	3.2	3.3	3.9	4.7	5.2	5.1	5.5	7.5	5.6	4.2	3.3	3.3	4.6	7.5	3.2

The amount of rainfall in Bani Nai'm in 2016/2017 was (Palestinian Meteorological Department)

Table 3.4: In the attached table above, depending on the Palestinian Meteorological Station, we show the amounts of rain in the Bani Nai'm region for the year 2016/2017, in addition to the percentage of precipitation mm

The amount of cumulative rain	274.5
General Average for all month (2016/2017)	392.4
Percentage of rainfall (2016/2017)	70

3.4 Studying chemical and physical properties of runoff

The amount of precipitation over a certain area may cause surface runoff, and runoff is usually defined as part of rainwater or irrigation water that may extend above the surface of the soil to the waterways instead of being absorbed by the soil.

Surface runoff process is affected by several factors: the duration and intensity of the rains, the meteorological condition and the season of the year, watershed, slope, shape, soil.

Surface runoff affects soil erosion and sediment transport, as the erosion scenario consists of three phases: separation, transport, and precipitation of particles. The relationship between precipitation and sediment transportis very variable and depends on the factors previously mentioned and that affect surface runoff .From this perspective, the interest in studying the runoff that occurs in the wadi was through taking samples over two consecutive years and different months, in addition to different places to estimate the quantities of runoff that affected the wadi. This is to try to evaluate the effect of surface runoff on sediment transport (A. Balasubramanian, 2017).

3.5 Sediment Settling and Storage:

Due to the sedimentation processes to which the sediment is exposed, they are usually affected and are arranged in layers called beds, and this is clearly evident in sedimentary rocks, where the layer is arranged due to differences in the color of the material, differences in grain size, or differences in mineral content or chemical composition. It is considered as a clear archive of the weather conditions that surrounded the region in the past.

3.6 Factors affecting the transport and arrangement of sediments:

It is important to study the influences that mainly affect the transport and arrangement of sediments, and these influences are summarized in important points which are: inclination, texture of sediments, and other physical properties of the wadi and sediments as well.

3.6.1 Slope:

Sediment transport is also affected by the slope of the wadi, as the slope increase, the runoff rate increases, so the sediment transport will be much more. It should be noted that the type of sediments or the type of beds in terms of texture increases the quantities of sediments, as sandy soil has more corrosion than others on steep slopes while the silty clay loam soil has more corrosion on light slopes (Duley et al 1932)

3.6.2 Urban and Agriculture:

On the other hand, studies have shown that the uses of land and vegetation cover significantly reduce surface runoff as the relationship between them is inverse, and this can be observed in the study area where the lack of vegetation and the lack of land use for the lack of capabilities in the wadi increases significantly in the Surface runoff, sediment transport, and erosion (Zhang 2010).

3.6.3 Infiltration rate:

Therefore it is necessary to know the quantities of infiltration in sediments and the course of runoff, to understanding the balance of surface water in the wadi. Note that the wadi does not fall on a water reservoir and its layers are not executed.

Table 3.5: standard infiltration rate mm/hr according to soil texture type by Brouwer, C (1988).

Sample name	soil type	Infiltration rate mm/Hr
GA-UP-SS1	Loam	0.365631
GA-UP-SS2 a	Silty loam	1.389397
GA-UP-SS2 b	Clay loam	0.182815
GA-UP-SS2 c	Clay	0.091408
GA-UP-SS3 a	Clay loam	0.182815
GA-UP-SS3 b	Clay loam	0.182815
GA-UP-SS3 c	Clay loam	0.182815
GA-Up-SS3 d	Loam	0.365631
GA-Up-SS3 E	Sandy loam	0.548446
GA-Up-SS3 F	Loam	0.365631
GA-Up-SS3 J	Loam	0.365631
GA-Up-SS3 H	Loam	0.365631
GA-UP-SS4 a	Loam	0.365631
GA-UP-SS4 b	Loam	0.365631
GA-UP-SS4 c	Silt loam	1.389397
GA-UP-SS4 d	Sandy loam	0.548446
GA-UP-SS5a	Sandy loam	0.548446
GA-UP-SS5b	Sandy loam	0.548446
GA-UP-SS6	Sandy loam	0.548446
GA-UP-SS7 a	Silty loam	1.389397
GA-UP-SS7 b	Sandy loam	0.548446
GA-UP-SS 7c	Loam	0.365631

In the table above (table 3.5) it shows the quantities of infiltration based on sediments texture (figure 4.2) present in the region, and this is a prediction of the quantities of water that can reach the groundwater in addition to the quantities of water in which the sediments can be preserved before erosion operations, and this works as a deterrent to reduce the quantities of surface runoff.

Table 3.6: Sediments Parameter according to sediments texture (figure 4.2). Clapp and Hornberger (1978) parameters for equation

Soil Texture	Porosity n	K_{sat} (cm/hr) Hydraulic conductivity	$\lvert\psi_a\rvert$ (cm) Soil suction head	B parameter is referred to as the pore size distribution
Sand	0.395 (0.056)	63.36	12.1 (14.3)	4.05 (1.78)
Loamy sand	0.410 (0.068)	56.16	9 (12.4)	4.38 (1.47)
Sandy loam	0.435 (0.086)	12.49	21.8 (31.0)	4.9 (1.75)
Silt loam	0.485 (0.059)	2.59	78.6 (51.2)	5.3 (1.96)
Loam	0.451 (0.078)	2.50	47.8 (51.2)	5.39 (1.87)
Sandy clay loam	0.420 (0.059)	2.27	29.9 (37.8)	7.12 (2.43)
Silty clay loam	0.477 (0.057)	0.612	35.6 (37.8)	7.75 (2.77)
Clay loam	0.476 (0.057)	0.882	63 (51.0)	8.52 (3.44)
Sandy clay	0.426 (0.057)	0.781	15.3 (17.3)	10.4 (1.64)
Silty clay	0.492 (0.064)	0.371	49 (62.0)	10.4 (4.45)
Clay	0.482 (0.050)	0.461	40.5 (39.7)	11.4 (3.7)

3.6.4 Sediment texture:

Study the soil texture to determine the composition of the soil in terms of the quantities of <0.002 mm (clay), 0.002 to 0.05 mm (silt) 2.00mm < (sand). What determines the quality of soil texture is the amount and speed of water flow between the fine particles of the soil according to fractional size of particle >2000 μm - < 63 μm.

Understanding soil texture helps try to predict corrosion and storage of organic materials. Also, it can help to understand the amount of transport and sedimentation processes that may affect the quantities of deposits resulting from the corrosion process based on their physical characteristics, which are the texture of the soil. Soil texture was examined by Simplified Method for Soil Particle-Size Determination (Kettler 2001).

3.6.5 Hjulstrom Curve:

This diagram depends on the quality of the transferred sediments and the flow velocity of the runoff. It aims to understand the relationships between erosion, transport and sediment deposition. For example in both samples GA-UP-SS3 and GA-UP-SS4, the two have the highest sediment ratio in both masses, as it is clear that the flow velocity they were exposed to was lower due to channel duct conditions and sediment texture.

3.6.6 Runoff Volume and Measurements:

It is important to understand and study the quantities of surface runoff that occurred in the region in order to try to estimate the quantities of transported sediments and the extent to which sedimentary masses are affected by the processes of induction and erosion due to weather factors that explain and prove whether the sediments are moving or not, and this is done by calculating the quantities of surface runoff from the quantities The rain that fell on the surrounding areas due to the lack of rain in the wadi due to the sharp decline that characterizes it

3.7 Observing sedimentary storage:

Storing sediments in the wadi and determining the quality of beds, was done by observing the sedimentary dunes in the stream. Consequently, a number of existing species were identified which were helpful to analyze the flow runoff transport affecting the stream. Note that the runoff follows two streams, namely the al-masyadah and al-ma'azza. It is important to study it because it explains the formation of sedimentary rocks, where scientists are interested in it because it explains the type of source rocks and weathering operations in addition to sorting them according to transport and sedimentation processes.

3.8 Chemical analysis of sediments:

In order to try to understand the origin of sediments in the wadi, a large number of previous studies were reviewed, and it was found necessary to study the chemical properties of sediments, as the study relied mainly on the Trace element, major element, rare earth element, isotope analysis and the TOC and TNb.

Geochemical analyzes of sedimentary rocks provide an important insight into tectonic conditions that affect the following complex factors: including origin, transport, meteorological factors, and deposit position. From this perspective, the elements analyzed according to the periodic table were divided into three sections: major elements plot, trace elements plot and normalized REE

3.9 Experimental Section

The sediment samples were taken with high accuracy and in a planned form for a comprehensive study to try to understand the sedimentation methods and the origins of the transferred sediments. About one kilogram of each sample was taken for chemical and physical analysis at different heights from each layer in each sample.

It was dried at room temperature for 48 hours, then sifted using a 2mm sieve for accurate examination. The extraction method was adopted for all analyzes SOP (CCBA-SOP-004). pH and electrical conductivity were analyzed using a device WTW multi-meter 3034i SOP (CCBA-SOP-005). On the other hand, Alkalinity and chloride were analyzed by using the titration method SOP SOP (CCBA-SOP-009), (CCBA-SOP-008), Also, soil texture was done by using 30g>2mm air-dry soil in 100ml D.W containing 3% Sodium Hexameta Phosphate (Kettler, T. A et al 2001). As for TOC and TNb, it was done using a selective TOC device, 10 g of sediment in 100 ml D.W, and then shaking for 1 h. then using the filtered liquid after filtration by millipore 0.25 mm filter.

Chemical analysis (Trace element, Major element, REE) was done using an ICP-MS device that done by using 2.5 g in 25 ml Milli-Q water with 3% HNO_3 and shaking overnight, then filtered using millipore 0.25 mm filter.

Chapter Four:

Result and Discussion:

Sedimentary rocks in the area are exposed to corrosion due to surface runoff and bad climatic conditions in the study area. This is evident on the sediment and the minerals in which it is concentrated, as each mineral concentration indicates the origin of sedimentary stones. Sedimentary rocks are divided into three types: (i) Clastic sedimentary rocks, (ii) Chemical sedimentary rocks and (iii) Organic sedimentary rocks. Studying the types of sedimentary rocks facilitates the process of identifying the origin of sediments transported in the area by knowing the types of minerals available in sediments.

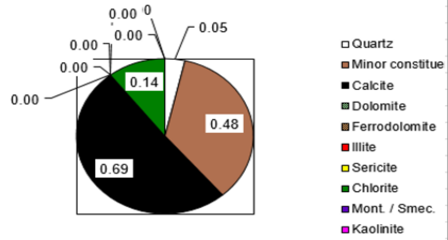
Sediments are characterized by the abundance of mineral elements possessed, through our study of the chemical and physical properties possessed by the selected samples can determine the origin and ways affected by surface runoff in the study area and this is to study the original composition, which usually consists of phyllosilicates, quartz, plagioclase and K–feldspars. From this scene, we have studied rare earth element, major elements, and trace elements.

4.1.1 Mineralogy:

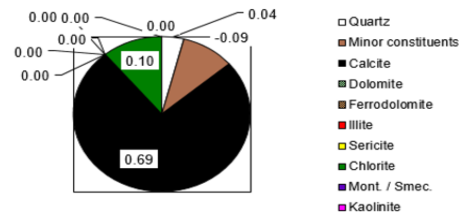
Selected area was faced harsh environment, and bad weathering that causing soil and rock erosion. Studying and monitoring movable sediment helping to explanation element that found during analysis, value of pH and EC.

The method that using to determine the sediment type is by making element as plot, which signifies mineralogy and composition of the sample. Element that used are (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, P_2O_5, MnO, Cr_2O_3), these minerals are present in the earth's crust, and these trace elements are distinguished by their carrying on sediments rather than being carried in surface runoff, in addition to being transferred from the earth's crust to the clastic sedimentary masses (McLennan 2001)

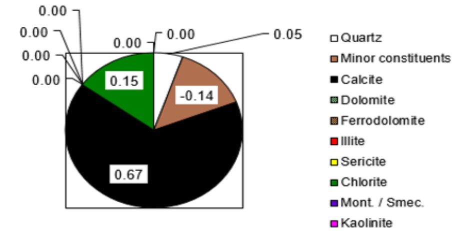
Through study sediment and compared the result with previous study its found matching in minerology that is very helpful to confirmation sediment fingerprinting. The sediment composition clarify high concentration of trace elements and major elements that found during analysis (Figure 4.1)



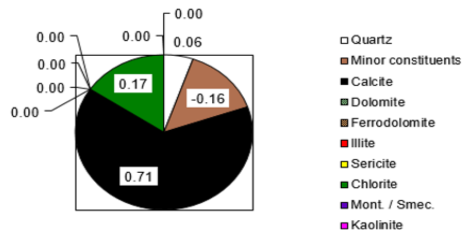
GA-UP-SS1

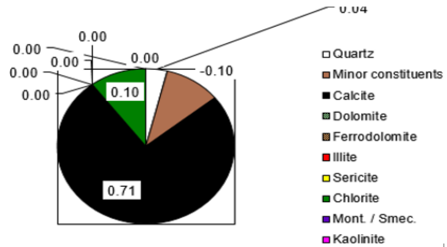


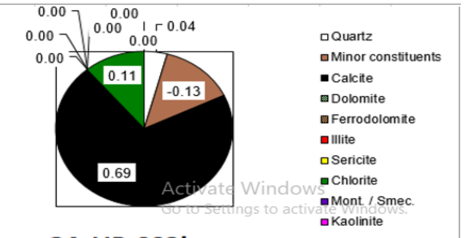
GA-UP-SS2a

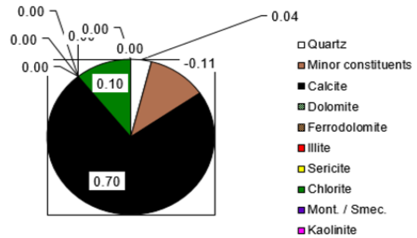


GA-UP-SS2b

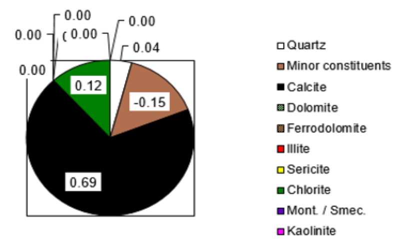




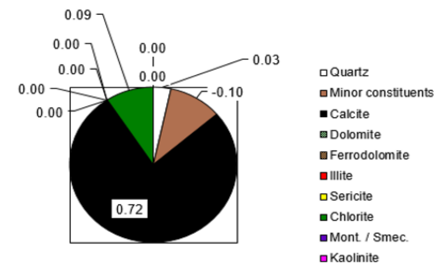




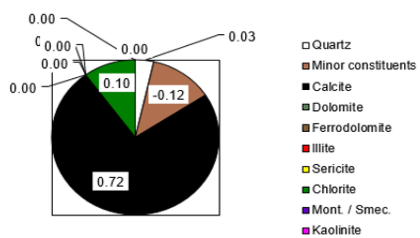
GA-UP-SS3C



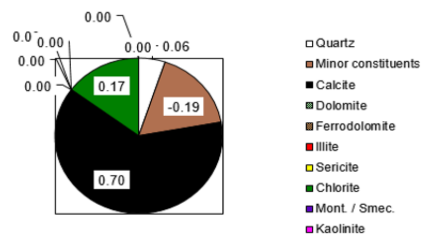
GA-UP-SS3d



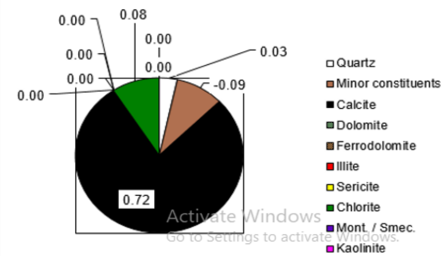
GA-UP-SS3e



GA-UP-SS3f



GA-UP-SS3j



GA-UP-SS3h

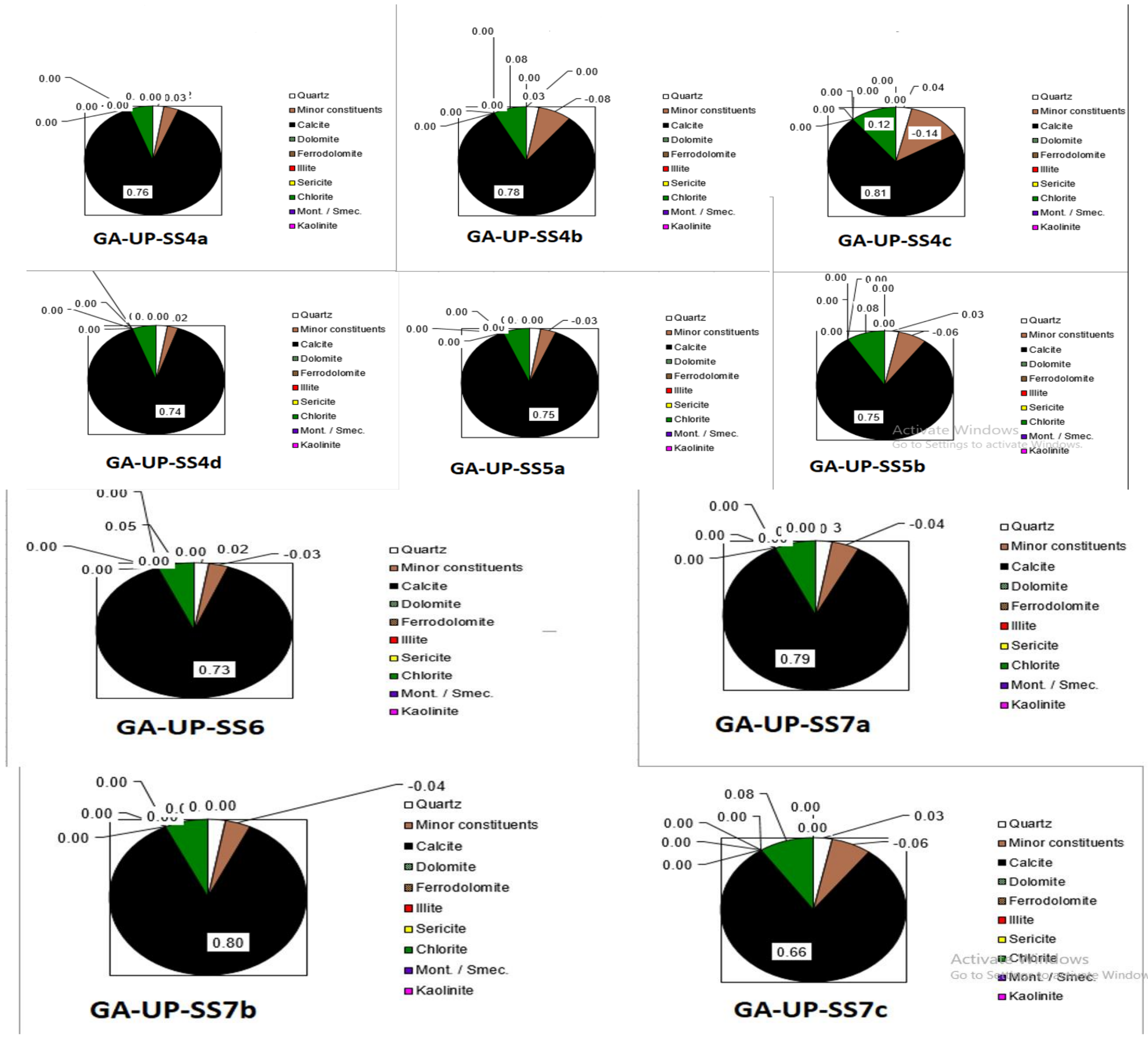


Figure 4.1: Results of determining the minerology of sedimentary rocks in the valley by using sediment sedimentary mineral calculator.

The following figures (figure 4.1) show the composition of the sediment, the largest share of calcite (CaO - CO_2) which consists of, followed by dolomite (CaO - MgO - 2CO_2) and then minor constituent's (Gypsum, Pyrite, Apatite, Albite, K-spar, Rutile, Hematite) , then quartz (SiO_2)

In the attached table (table 4.1), the type of sedimentary rocks along the course of the wadi was determined by specifying the geological form in the wadi

Table 4.1: geological formation Vs. rock type in the wadi, Hussam Utair 2013.

Type of soil in wadi al-Ghar according to geological formation, the best geological formation of groundwater is Yatta and Bait Kahel Formation where it had a thickness of the groundwater system in this area ranges from 500-970 meters			
Yatta Formation	Limestone	Dolomite	
Hebron Formation	Dolomitic limestone	Gray Limestone	Gray Dolomite
Jerusalem formation	karstified Limestone	Dolomite with marl	Clay mainly near the bottom
Abu dies formation	Chalk	Chert	
Bait Kahel Formation (upper Bait Kahel)	Limestone	Dolomite	

The geological layers spread in Palestine date back to the two eras, Holocene and Pleistocene, while in Late Cretaceous era silicate metamorphic rocks were formed the marble, Marl, poplar, Dolomite rocks, and flint rocks These geological layers that cover the study area in the first geological periods. The type of soil that each geological formation which is known as sedimentary rocks possesses supports the analysis made by trying to determine the type of rock present in the area. This explains why the Mineral Element and the Element of Element are very high in the wadi as Ca, Mg, Na, and Si.

The type of sedimentary dunes studied in the wadi was determined using the sedimentary mineral calculator, after converting the values of the following elements (SiO2, Al2O3, Cr2O3 P_2O_5, TiO_2, MnO, CO_2, Fe_2O_3, K_2O, MgO, CaO, and Na2O) to wt% oxide.

Due to time constraints and lack of sources, the results that were analysed from the ICP-MS device for the sediments were used and converted to Oxide by using Element — Oxide

Conversions. The study of metallurgy was striking due to its importance in helping to determine the origin of the sediments by trying to identify minerals and their distribution methods. From that, after trying to determine the type of minerals the sedimentary dunes possess, it was found that the largest percentage is occupied by calcite, which mainly consists of the deposition of calcium carbonate, and through reviewing previous studies (table 4.1) , it was found that limestone, a type of calcite, contained mainly in the geological formation in the area. Where this means that the cycle of sediment transport in the same area is a result of erosion processes in sedimentary rocks previously present in the wadi

4.1.2 Runoff measurement and chemical analysis:

The high areas surrounding the wadi are affected by the amounts of large rainfall, and this works to form a runoff that has a course that travels the waterways depending on the inclination, which leads to its transmission through the wadi. Surface runoff quantities are very large and extend over hours, which works to erode sedimentary rocks, transport sediments carried over the stream and transport them from one place to another. This necessitated calculating and analyzing surface runoff quantities to try to understand how the sediments were transported. Of course, repeated samples were taken from the same regions and at different times (the beginning and the end of the flood).

Initially, surface runoff quantities were calculated using the following law (Number):

The simplest method of estimating mean annual runoff is to apply a runoff coefficient to the mean annual rainfall over the catchment (Batalla and Vericat 2010):

$$MAR = k.\ MAP$$

Where:

- ✓ MAR = Mean Annual Runoff (mm)
- ✓ MAP = Mean Annual Precipitation (mm)
- ✓ k = runoff coefficient (0.05 for large catchment, 0.10 for smaller catchment)

For our observatory in the study area we realize that the precipitation range was 392.4 mm in 2017/2018.

Calculation of runoff volumes

By knowing rainfall amounts, runoff amounts can be calculated:

$$ARV = MAR.\ A.\ 1.000$$

$$ARV = 392.4\ mm * 240\ Km^2 * 1.00$$

Runoff Volume is 94176 m^3

Where:

- ✓ ARV = Annual Runoff Volume (m^3)
- ✓ MAR = mean annual runoff (mm)
- ✓ A = catchment area (km^2)

According to data 2014 runoff volume was 94176 m^3, this calculation emphasizes the bad situation facing the wadi, showing the large erosion of the sediments that were transported along the stream of the wadi and formed in other areas in sedimentary masses. Also, the surface runoff rates should be concentrated in comparison with the amount of storage by soil type in each area and infiltration rates into the soil. On the other hand, the quantities of evaporation, which is one of the characteristics of the region high temperatures.

Service runoff equation:

$$Q = (P-I_a)^2/(P-I_a)+S$$

$$(392.4\ mm-0.27273)^{2\,/}\ (392.4\ mm-0.27273)+1.363636=$$

9994.67 mm

- ✓ Q= runoff (in.)
- ✓ P= rainfall (in.)
- ✓ I_a= initial abstraction (in.)
- ✓ S= potential maximum retention after runoff begins (in.)

Runoff rate= Rainfall Intensity-Infiltration Capacity

= 98.1 mm/h -20 = 78.1

Assessment of annual or seasonal runoff:

K= (Yearly (seasonal) total runoff mm)/ (Yearly (seasonal) total rainfall mm)

$$= (94176\ m^3)/\ (392.4\ mm) = 240$$

Table 4.2: Surface runoff samples that were taken and analyzed

Parameters Sample Name	pH	EC µS/cm	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	HCO_3 (mg/l)	Na (mg/l)	K (mg/l)	TOC (mg/l)	TNb (mg/l)	PO_4^{-3} (mg/l	SO_4^{-2} (mg/l)
GA-UP-L1012018	7.94	311.33	42.08	30.78	685.37	370.19	7.56	5.99	22.51	3.76	0.02	9.00
GA-UP-L2012018	7.91	368.00	46.63	31.19	685.37	1834.67	30.24	0.75	22.38	4.91	0.09	9.00
GA-UP-L3012018	7.86	394.00	62.79	28.35	685.37	227.81	3.02	5.99	19.24	4.83	0.09	11.00
GA-UP-L1122017	7.92	222.00	20.04	13.77	14.18	508.50	18.15	18.73	10.21	3.16	0.71	0.00
GA-UP-L2122017	8.16	155.63	18.57	9.96	8.98	569.52	13.61	16.48	5.38	0.99	0.53	0.00
GA-UP-L1-2604018			46.76	40.50	105.17	284.76	33.03	7.74	34.61	5.00	0.30	70.00
GA-UP-L2-2604018			33.40	48.60	86.26	244.08	40.61	23.56	32.89	6.02	0.60	40.00
GA-UP-L3-2604018			65.46	445.50	86.26	284.76	43.86	15.24	41.08	6.50	0.20	60.00
GA-UP-L4-2604018			60.12	36.45	89.81	166.79	34.65	9.85	31.33	6.84	0.60	40.00
GA-UP-L5-2604018			58.78	46.17	98.08	305.10	37.36	12.31	31.97	6.64	1.00	30.00
GA-UP-L6-2604018			64.13	48.60	82.72	166.79	34.11	9.85	26.24	6.08	0.60	70.00
GA-UP-L7-2604018			78.82	53.46	77.99	276.62	36.28	6.56	49.72	2.43	0.20	50.00

Rare Earth Elements concentrations in surface runoff samples were very close to zero or undetected, and it is clear through monitoring that surface runoff does not move these elements or the low average concentrations in sediment masses in the region (Table 4.3) .This is due to the inability of REE to be transported by surface flow due to they have a very low solubility product

Table 4.3: REE result in ppm for runoff sample, Nd: not detected, unite ppm*$10^{\wedge-5}$

Sample ID	Sc	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
GA-UP-L6-2604018	344.49	102.69	87.36	152.92	20.02	67.46	14.29	11.41	19.73	2.15	16.38	2.47	7.33	0.61	5.62
GA-UP-L7-2604018	276.68	50.81	37.75	76.17	8.52	33.71	8.17	11.19	8.86	0.90	6.25	1.17	3.84	0.22	3.21
GA-UP-L2012018	91.82	1.02	0.75	0.79	Nd	0.99	0.27	2.55	Nd	Nd	0.01	Nd	0.10	Nd	0.49
GA-UP-L1012018	85.37	1.08	0.58	0.74	Nd	0.93	0.82	2.60	0.19	Nd	0.13	Nd	Nd	Nd	0.24

In the attached table 4.3 it shows the values of Rare earth elements carried on surface runoff samples, as it is noted that the sample values are close to zero or have not been detected because REE are not transmitted by runoff, in addition to their low rates because there is no source for them because the rocks. The sediment spread in the area possess it in very small proportions.

Table 4.4: Trace element values for runoff sample, unite ppm

Sample ID	GA-UP-L6-2604018	GA-UP-L7-2604018	GA-UP-L2012018	GA-UP-L1012018
Li	0.13	0.14	0.16	0.13
B	0.13	0.11	0.13	0.07
Na	15.81	33.27	26.1	20.18
Mg	118.05	11.23	15.89	9.1
P	5.05	0.72	0.53	0.66
Fe	186.33	2.73	2.81	1.62
Te	0	0	Nd	Nd
Cs	Nd	Nd	Nd	Nd
Ba	2.55	0.16	0.15	0.07
Tl	Nd	Nd	Nd	Nd
Pb	Nd	Nd	Nd	Nd
Bi	Nd	Nd	Nd	Nd
Al	0.02	0.01	Nd	0
K	17.16	15.7	8.85	7.08
Ca	1331.11	21.36	17.02	13.54
V	0.01	0.02	0	0.01
Cr	0	Nd	Nd	0
Mn	2.1	0	0	Nd
Co	0.01	0	0	0
Ni	0.02	Nd	Nd	Nd
Cu	0	0.01	Nd	Nd
Zn	0.19	0.37	0.11	0.15
As	0.01	0	0	0
Se	Nd	0	Nd	Nd
Mo	1.26	1.02	2.61	0.46
Cd	0	Nd	Nd	0
Si	7.79	10.34	6.54	6.26

4.1.3 Study a weather factors that affect sediment transport and sedimentation:

This was done by dividing the study into three sections:

(1) Environmental effects, which include slope (figure 3.1), rainfall rates (table 3.3), and the geological form of the region (figure 1.1), as they have proven to have a significant and important role in the transfer and sedimentation also, as the geological form of the region contributes to limiting and sedimentation in areas in the wadi and work the increase in transmission in other areas is due to shear stress, channel roughness, speed, and rainfall rate. Which can represent as sediment texture (figure 4.2), and Hjulstrom Curve where it assessment the relation between sediments size and the velocity required to erode (figure 4.3). This figure shows the type of sediments and their sediment or transfer based on its texture, and most sediment that has more Practical Size as sand will deposit.

(2) Monitoring the processes and methods of sedimentation (figure 4.4-4.9) during two different seasons (rainy and dry), and this indicated the increase of precipitation during the following season to more than one layer (figure 4.10-4.13), and studying the layers that were deposited during this. The process of formation of sediments is affected by surface runoff and its effect on soil erosion. This depends on the roughness of the sediments and the organic carbon content in addition to the amounts of precipitation that cause surface runoff.

To calculate the quantities of surface runoff, the dependence was taken on the calculations of the rainfall intensity affected by the region, based on the amounts of rainfall in the Bani Naim region for the year 2017-2018 taken from the Palestinian Meteorological Station (table 3.4). The volume of surface runoff, which equals 94176 m3, was calculated.

The same applies to water infiltration of the soil, where it is affected by the intensity of the surface runoff, especially in the first ten minutes, depending on the roughness of the sediments. The soil with medium or clay texture (figure 4.2) that does not have a vegetation cover on the surface is characterized by a lack of water infiltration and an increase in runoff. From this the sediment texture was used to determine the infiltration of water (table 3.5). As for the organic carbon content, it contributes to forming more and more stable agglomerations by providing a good environment for the roots. This works to infiltrate the water more into the soil and lower the level of surface runoff (Almeida 2019).

Other factors that influence surface runoff and sediment quantities are Porosity, Hydraulic conductivity, Soil suction head, pore size distribution (table 3.6). Sedimentary rocks have a porosity of about 30% to 10% and they have less porosity due to the size of grains, sorting, pressure, and the degree of solidification of the rocks, where high porosity works to flow water easily into the soil and facilitate the infiltration process, but in the sediment samples present there is a small porosity ratio ranging between (0.395-0.492). It is clear that there is an inverse relationship between the porosity and the hydraulic conductivity in some samples due to the increased flow and increase in the fine part.

(3) Studying the Weathering Intensity and Chemical Maturity: It is important to study the climatic and weathering effects on sediments in the region through special equations for the study of minerals, which are as follows: (i). CIA ratio,(ii) PIA, (iii) CIW, (iv) CIW', (v) WIP

I. Chemical Index of Alteration: Used to assess the amount of climatic effect on feldspar to measure the amounts of alumina transformation, basically is considered as an indicator of the degree of weathering and chemical changes, and study the extra mortar mineral weathering and migration characteristics of each element. Which is a cracking in sediments made of feldspar and formed in other species. Which is play an important role in changing in sediment provenance. value if the optimum fresh value are $\leq$ 50% then the ideal trend of index up-profile (increase in weathering) is positive, and this are indicator to aluminum immobility (Nesbitt and Young .1982)

$$CIA = ((Al_2O_3 / (Al_2O_3 + CaO + Na_2O + K_2O)) * 100$$

II. Plagioclase Index of Alteration: can be used as an alternative to CIW ratio. value if the optimum fresh value are $\leq$ 50 then the ideal trend of index up-profile (increase in weathering) is positive, and this are indicator to aluminum immobility (Fedo et al. 1995)

$$PIA = ((Al_2O_3 - K_2O) / (Al_2O_3 + CaO + Na_2O - K_2O)) * 100$$

III. Chemical Index of Weathering: calculated is similar to CIA ratio by marginalizing the values of K_2O, it using to interpret evaluate the possibility of feldspar becoming clay. value if the optimum fresh value are $\leq$ 50% then the ideal trend of index up-profile (increase in weathering) is positive, and this are indicator to aluminum immobility (Harnois.1988)

$$CIW = ((Al_2O_3 / (Al_2O_3 + CaO + Na_2O)) * 100$$

IV. Weathering Index of Parker: This value shows the amounts of sodium, potassium, magnesium, and calcium transmitted by the surrounding climatic conditions due to weathering conditions, it use to evaluate the weathering for silica rocks. These conditions are the main process in the erosion of sediments, which causes the process of breaking links in mobile elements, but for these elements are considered as a strong indicator of weathering. Value if the optimum fresh value are >100% then the ideal trend of index up-profile (increase in weathering) is negative, and this are indicator to aluminum mobility (Parker.1970).

$$WIP= ((2*Na_2O/0.35) + (MgO/0.9) + (2K_2O/0.25) + (CaO/00.7))*100$$

These values were adopted based on the results of the analysis of our sediments, then they were compared with fixed values to determine the external influences as shown in (table 4.5). CIW and PIA value both are >50% this mean positive index for weathering but didn't allow Al to mobility. However, WIP value is dissent the index for both CIW and PIW where is >100% which is negative and allow Al to mobility. These values considered as the first interpretations that have been applied in the wadi, to study the weathering effect on sediments and can be considered as a reference for their use in another site.

Table 4.5: CIW, PIA and WIP ratio for each sample, each ratio is multiply by 10^{1}

Sample ID	CIW	PIA	WIP
GA-UP-SS1	0.03	0.05	575.52
GA-UP-SS2.a	0.03	0.19	324.99
GA-UP-SS2.b	0.07	0.27	350.16
GA-UP-SS2.c	0.06	0.19	367.64
GA-UP-SS3.a	0.02	0.27	524.09
GA-UP-SS3.b	0.02	0.25	756.88
GA-UP-SS3.c	0.05	0.43	579.62
GA-Up-SS3.d	0.06	0.24	814.47
GA-Up-SS3.E	0.02	0.26	614.26
GA-Up-SS3.F	0.06	0.20	724.22
GA-Up-SS3.J	0.07	0.26	800.28
GA-Up-SS3.H	0.02	0.23	533.56
GA-UP-SS4 a	0.02	0.25	400.68
GA-UP-SS4 b	0.03	0.14	569.81
GA-UP-SS4 c	0.02	0.14	816.26
GA-UP-SS4 d	0.02	0.25	343.23
GA-UP-SS5.a	0.03	0.44	332.48
GA-UP-SS5.b	0.03	0.39	342.38
GA-UP-SS6	0.02	0.47	323.47
GA-UP-SS7.a	0.01	0.39	392.43
GA-UP-SS7.b	-0.02	0.38	364.21
GA-UP-SS7.c	-0.05	0.65	316.53

4.1.4 Observation Sedimentation process and Sediment storage:

1) Sediment texture: The sediment texture adds important information about the granule distribution, weathering, and soil transportation. It mainly shows permeability, moisture, saturated hydraulic conductivity, and other physical properties of the soil. It may estimate the potential of sediments to absorb and transport chemicals. While it is important to know the particle sizes to predict the corrosion and precipitation quantities (Zhao et al 2011). Sediments vary in texture to clay loam, silt loam, sandy loam, and loam (figure 4.2), The silt particles have more movability, but for clay, they form as larger particles and are transported like this. Sand travels a lesser amount and works to resist the flow (Han et al 2019).

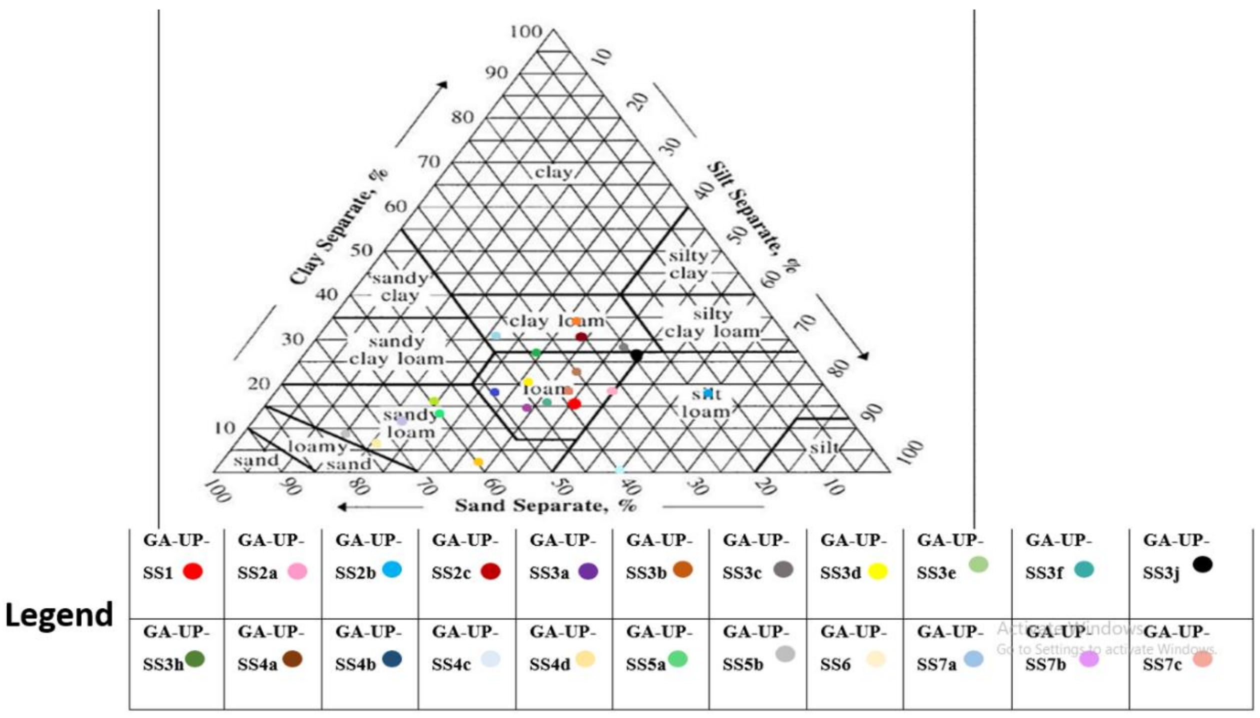


Figure 4.2: Sediment texture triangle, its show the sample variance according to texture type.

2) Hjulstrom curve: According to soil texture (figure 4.2) of sample sediment that we study, the attached graph (Figure 4.10) showing the quantities of sediments affected by velocity flow according to their diameter, where flow velocity The flow velocity is influenced by many factors: the roughness of the stream, the amount of flow etc. on the other hand as we notice four soil samples were deposit and not affected by the flow, which is GA-UP SS3, GA-UP SS4, GA-UP SS5, GA-UP SS6. These samples increased the layers in the sedimentary masses for one year, as they possess more layers than others. Clearly, channel conditions reduce flow velocity, which leads to sedimentation. Other particle were transported at the time were the flow start and end which it had low velocity rate. This curve shows the relationship between velocity and sediment transport in the stream or sedimentation as larger particles need a stronger velocity to travel.

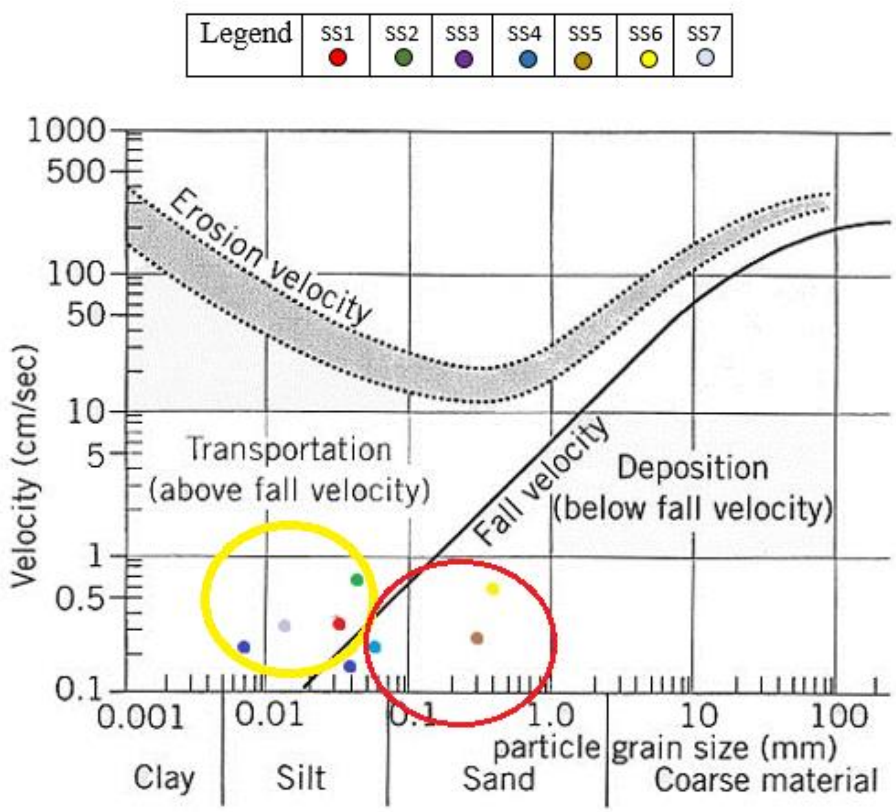


Figure 4.3: Hjulstrom curve explain the erosion, transportation and deposition process, for variables sediment particles according to velocity, samples in the yellow circle need more velocity to move them while samples in the red circle need less velocity.

Highest expected velocity 522.36 ft/s the samples will affected by the flow and will eroded and transported.

3) Observation sediment storage: The sedimentary rocks are a natural archive of the climatic conditions experienced by the region, hence the importance of observing the sedimentary rocks that exist in the region. The sedimentary rocks in the wadi are arranged in several beds, which can be seen in the figures below. Each bed indicates the type of rock, its formation, auxiliary conditions, and the minerals rich in it.

Figure 4.4: Rhythmic layering often formed by diffusion when it's fine, or it can happen in thermal conditions. It had high concentration of Al, Mg, Ca and Fe. Photo was captured by Soil and Hydrology lab/ al-Quds university

Figure 4.5: non-sorted sediment, it often formed when stream velocity suddenly decreases. It's mixed in size, shape, and density. Photo was captured by Soil and Hydrology lab/ Al-Quds university

Figure 4.6: mud cracks, usually occurs as a result of surface runoff that precipitates and dries up, resulting in cracking in the upper muddy part, often consisting of sedimentary rocks. Photo was captured by Soil and Hydrology lab/ Al-Quds university

Figure 4.7: graded bedding layering, This type often formed when a large water flow occurs and then begins to slow down, resulting in the precipitation of coarse sediments, then the finest, and then the flour gradually, and the flowing water is turbid. Photo was captured by Soil and Hydrology lab/ Al-Quds University

Figure 4.8: graded bedding layering, this photo was taken in wadi al-ma'azza, sample ID GA-UP-SS3. Photo was captured by Soil and Hydrology lab/ Al-Quds University

Figure 4.9: Sole marks layering, during the quiet times of the water flow, the fine particles that are suspended in the stream settle to form the silt and in the event of bad conditions and deep flow, the erosion of the clay layer and the sand layer above it. Photo was captured by Soil and Hydrology lab/ Al-Quds university

4) Sediment deposition and settling:

Due to the weather conditions that affected the area and the percentage of runoff, the area was affected by an increase in sediment mass layers. This was observed by monitoring for two years, this photo shows the apparent increase in the layers in this mass during the year 2018, as the layers increased from four layers to eight.

Thus it is easy to compare with the sedimentary mass a year ago that had fewer layers during 2017 as shown in the image below:

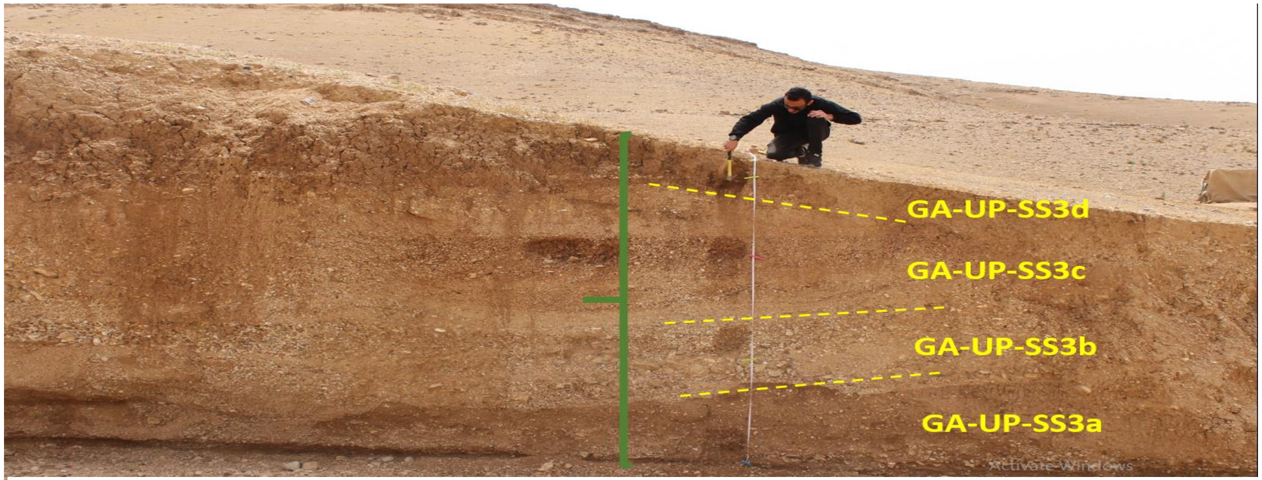


Figure 4.10: This image shows the high mass of sediments and the number of layers it possessed during 2017, and whose winter was dry due to the low amount of rain in it compared to 2018. Photo was captured by Soil and Hydrology lab/ Al-Quds University

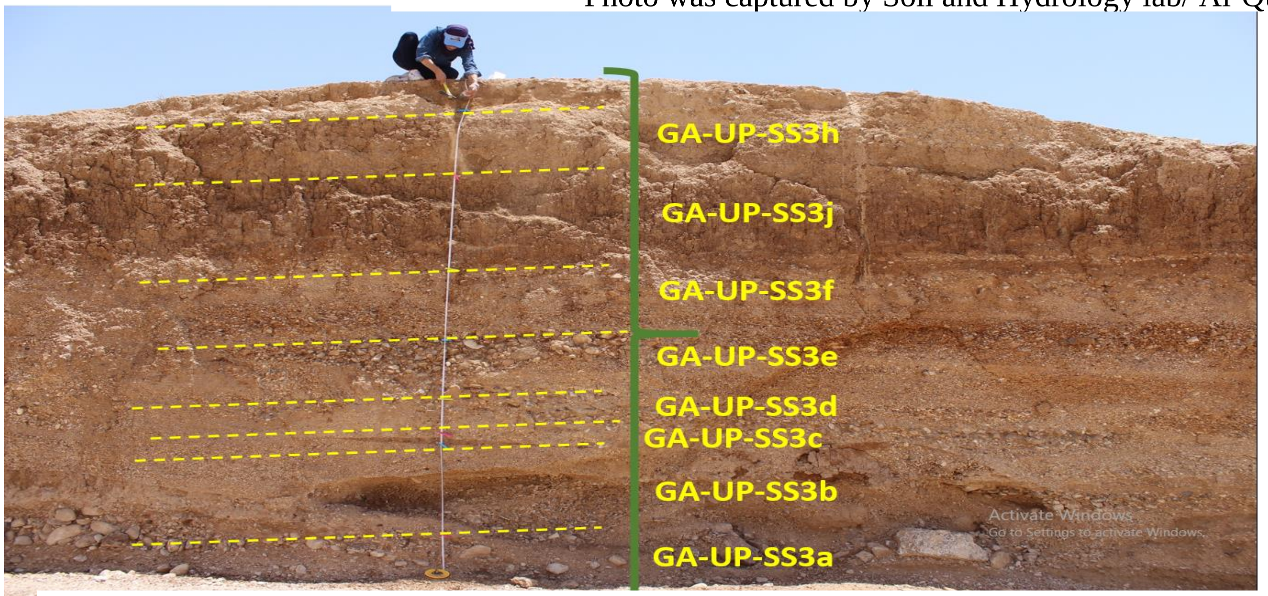


Figure 4.11: the sedimentary mass in 2018, which was affected by what increased the layers clearly. This indicates the transfer of sediments and their arrangement in new beds. Photo was captured by Soil and Hydrology lab/ Al-Quds University

On the other hand, sedimentary masses had an increase in the number of layers in another area that was in the Arabs al- Rashaydah in the SS5 sample.

Figure 4.12: GA-UP-SS5 sample in 2017, the sample is located at Arab Al-rashaydah. Photo was captured by Soil

Figure 4.13: GA-UP-SS5 sample in 2018 it is possible to notice the rise in the layers that occurred, as it only increased one thick layer within a year. Photo was captured by Soil and Hydrology lab/ **Al-Q**uds university

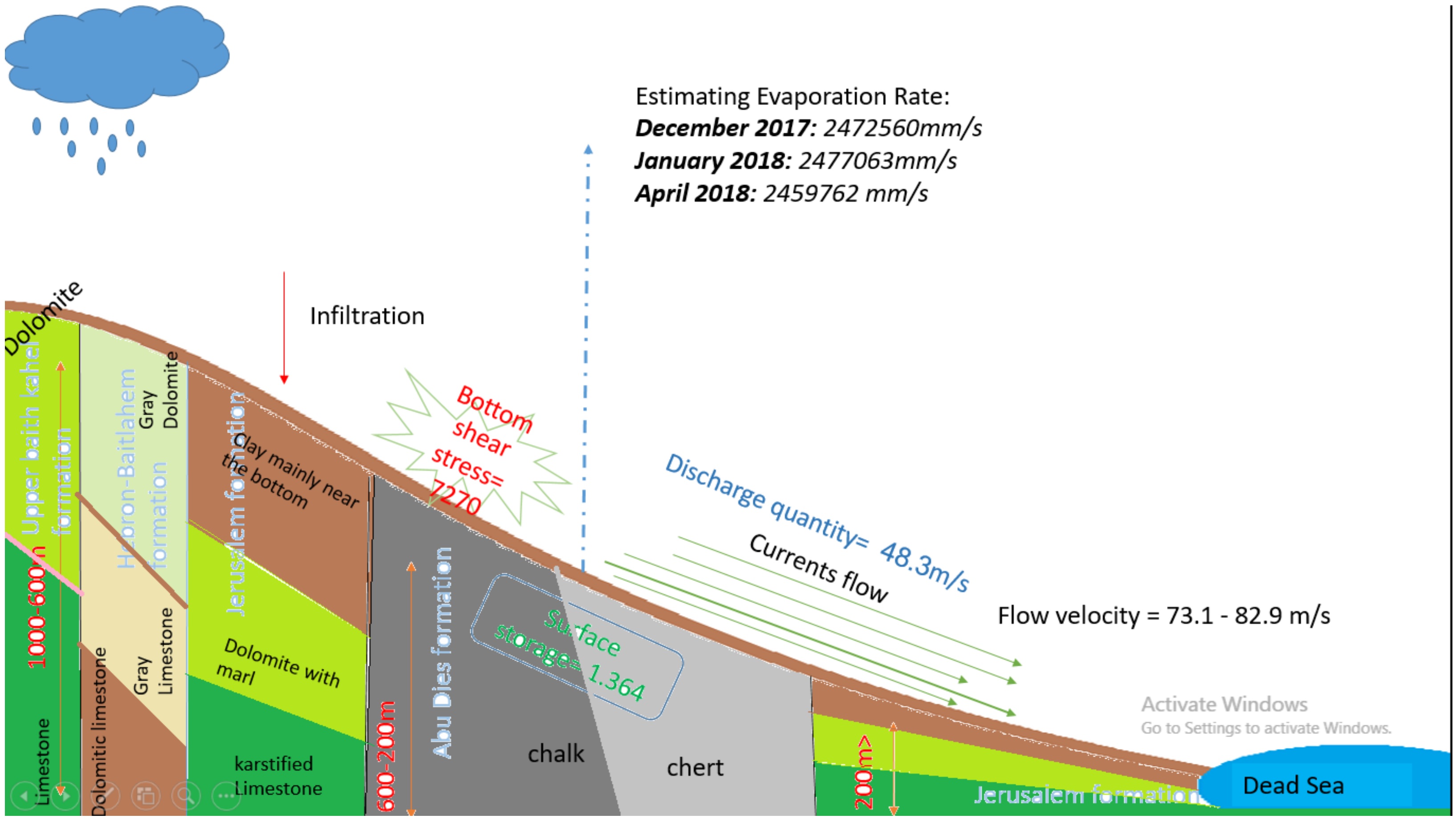


Figure 4.14: The scenario of sediment formation and sedimentation process in the wadi, the above figure shows the process of sedimentation occurring in addition to the types of geological formations and types of sedimentary rocks available in the wadi. As noted in the figure, a high rate of evaporation in August, due to the high temperatures that the wadi is exposed to during the summer (dry season) (table 3.3).

4.1.4 pH :

When the pH is measured, it should be noted that this value denotes the active hydrogen ion, and provides associated nutrition mineral in the clay. The results of pH reading in different regions showed that the soil is normal to a little bit more basic, with ph readings ranging from (7.8-9.1), which is a good indication that the samples had number of elements that increase the basal degree: (calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and sodium (Na^{+}) (McCauley 2009).

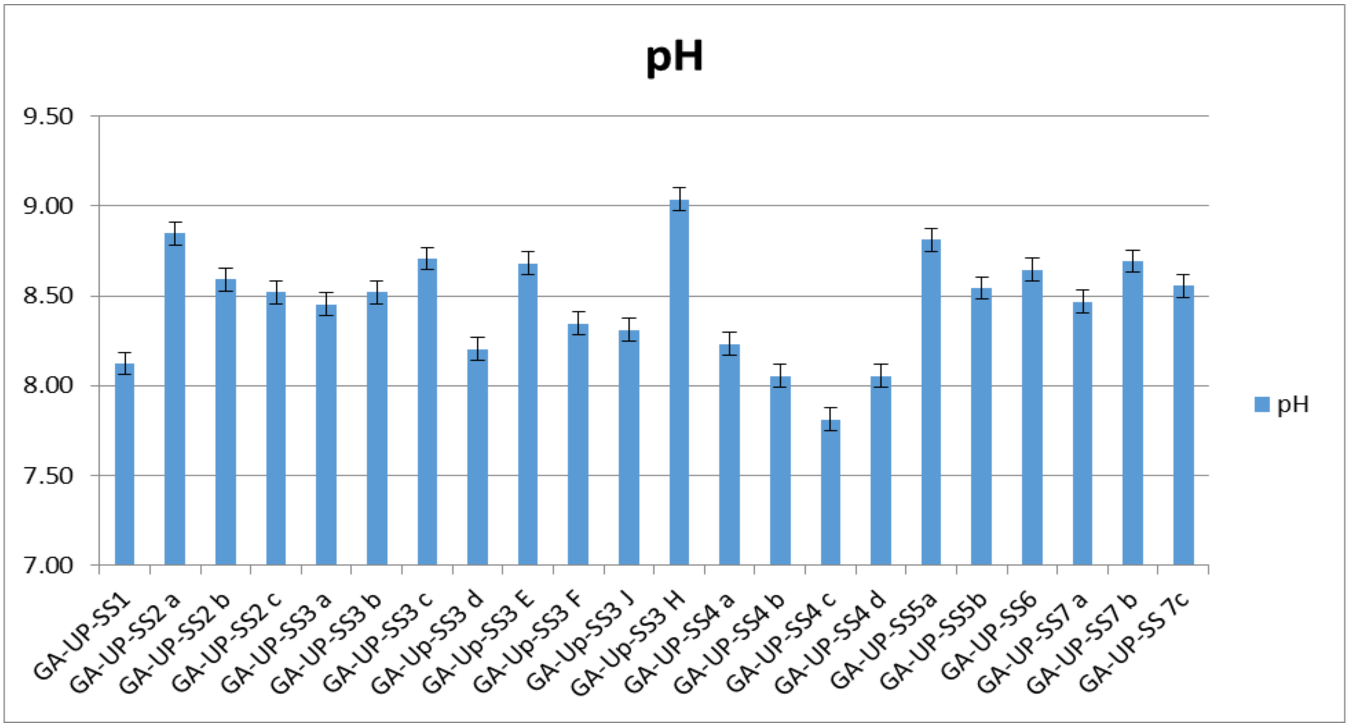


Figure 4.15: pH values for sediment samples

Of the basic parameters of the thermodynamic state in which multiple reactions and transfers can be affected within the natural environment, a hint biochemical indication (D. G. SHARP, et al 1946).As seen in the attached figure shows the range of pH ranging from (7.8 -9.04) which is slightly alkaline. The most high pH value is associated with carbonate-rich bedrock, it also coincides with limestone rocks, and some other rocks such as ultramafic, felsic, metamorphic and sedimentary rocks. Where Sediment transport increases with low pH. It should be noted that different pH and basal levels vary depending on the deposits of elements and ions that affect readings and pH. Obviously, the lowest reading was 7.8, which is more basal, which explains the presence of calcium by sedimentary rocks that affect values.

4.1.2 Electric conductivity (EC):

The Highest readings values evidence of the presence of the major dissolved inorganic solutes (essentially Na^{+}, Mg^{+2}, Ca^{+2}, K^{+}, Cl^{-} , $SO4^{-2}$, and HCO3-, NO_3^{-} and CO_3^{-2}) usually known as dissolves salts (FAO 1999). It's apparent in figure 10 that the highest value were in sample GA-UP-SS4C, followed by sample GA-UP-SS3J. Note that EC levels are high and range from 99 to 8,600, which accumulate through soluble salts, and high elements such as Na, Ca, Mg, K causing EC to rise. While the study area is rich in these minerals due to the sedimentary rocks present.

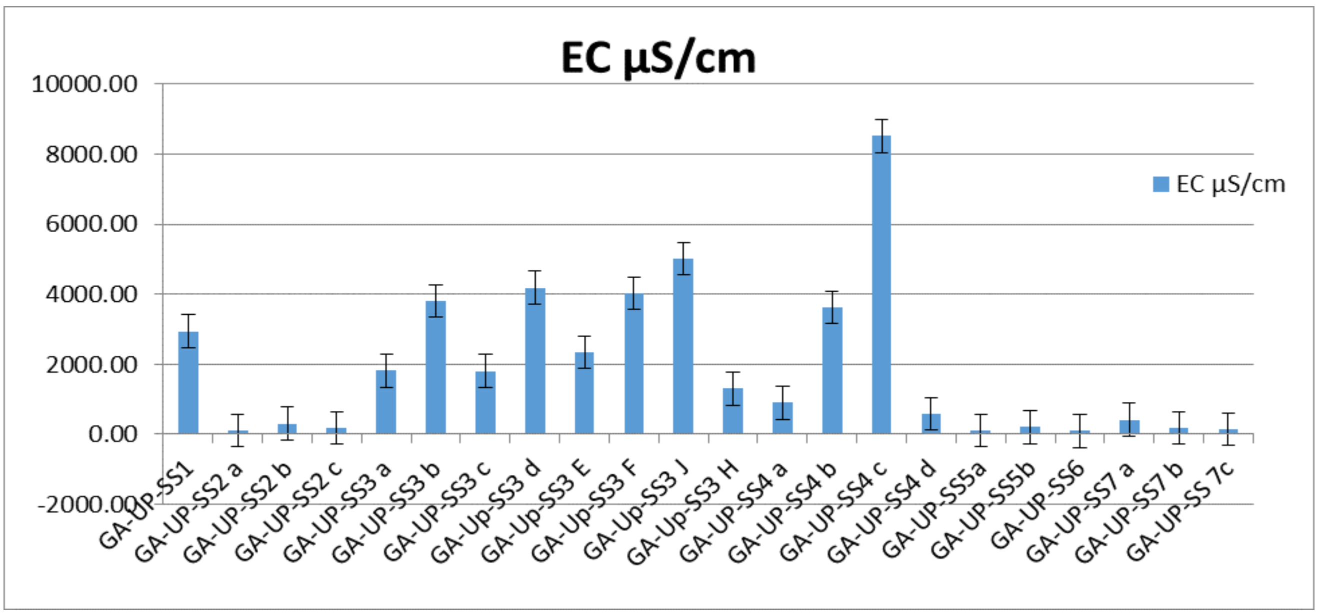


Figure 4.16: Electric conductivity for sediment samples

4.1.5 Chemical analyses of Sediments:

The analysis process for sediment and runoff samples were done by ICP-MS device based on the analytical method adopted at Al-Quds University. This method was adopted due to lack of time and resources (return to the experimental section). The process of analyzing chemical properties has been divided according to the study's need into more than one section: 1) Rare Earth element, 2) Major element, 3) Trace element.

4.1.5.1 Rare earth elemetnt:

REE is influenced by the chemical, physical and geological characteristics of the study area as these differences can affect the binding or dismantling of elements and their ratio in both runoff and sediments (Hannigan 2001).

We also found through our study for REE that the following elements (La, Ce, Nd, Y, Th, Zr, Hf, Nb, Ti and Sc) are very important in the knowledge of the origin of the sediment transferred, because they exist in very few percentages and do not carry during the process of sediment formation (Holland 1978). On the other hand, REE transmitted through sedimentary rocks during the process of induction and erosion (McLennan et al. 1983).

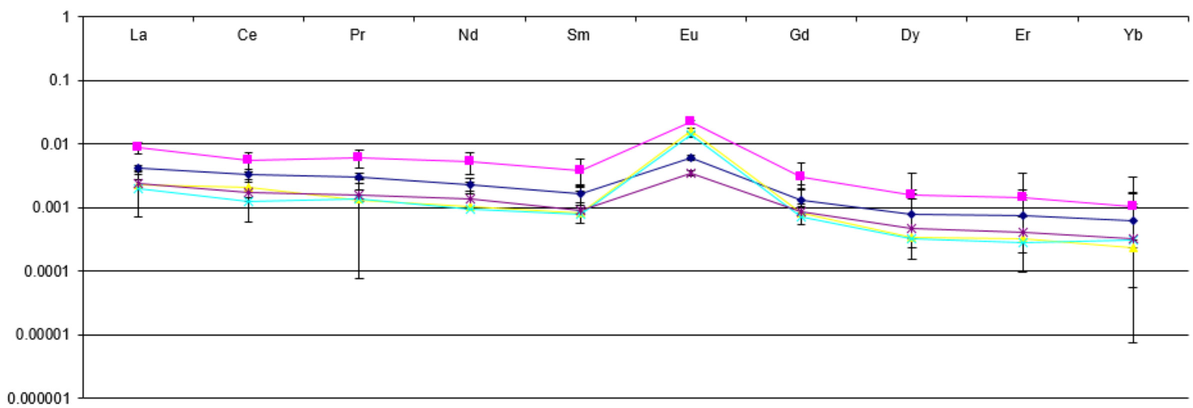


Figure 4.17: REE Chondrite normalized for ma'aza sample, Y axis represent REE Chondrite Normalisation

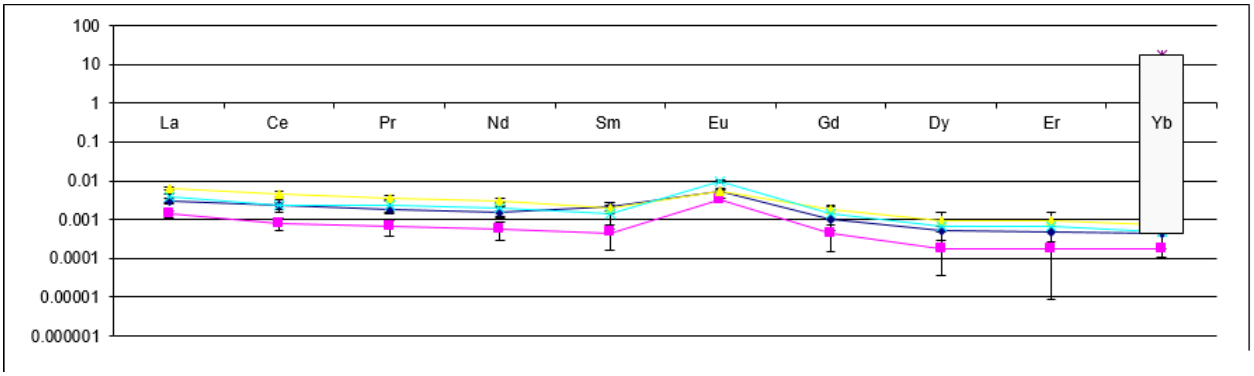


Figure 4.18: REE Chondrite normalized for Am greash sample, Y axis represent REE Chondrite Normalisation

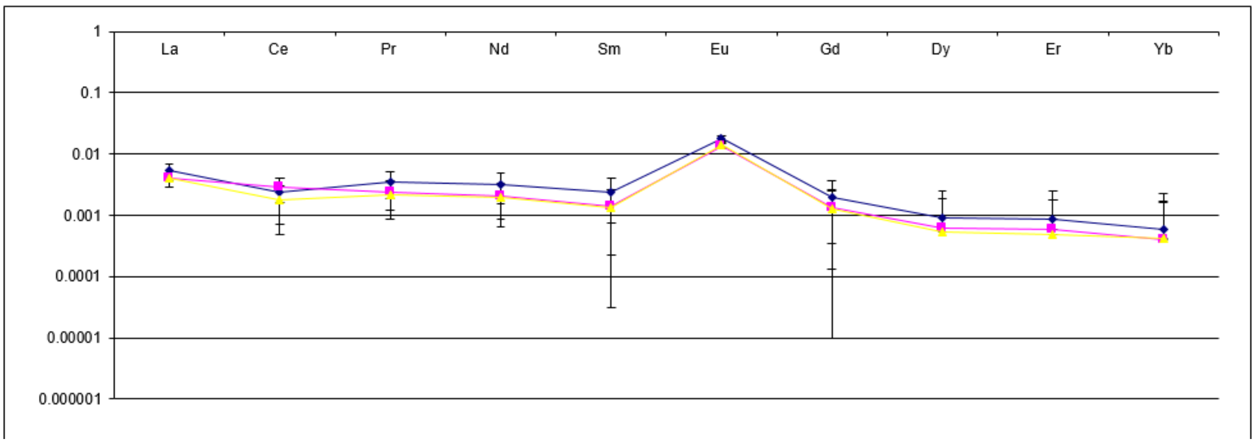


Figure 4.19: REE Chondrite normalized for Arab alrashayda sample, Y axis represent REE Chondrite Normalisation

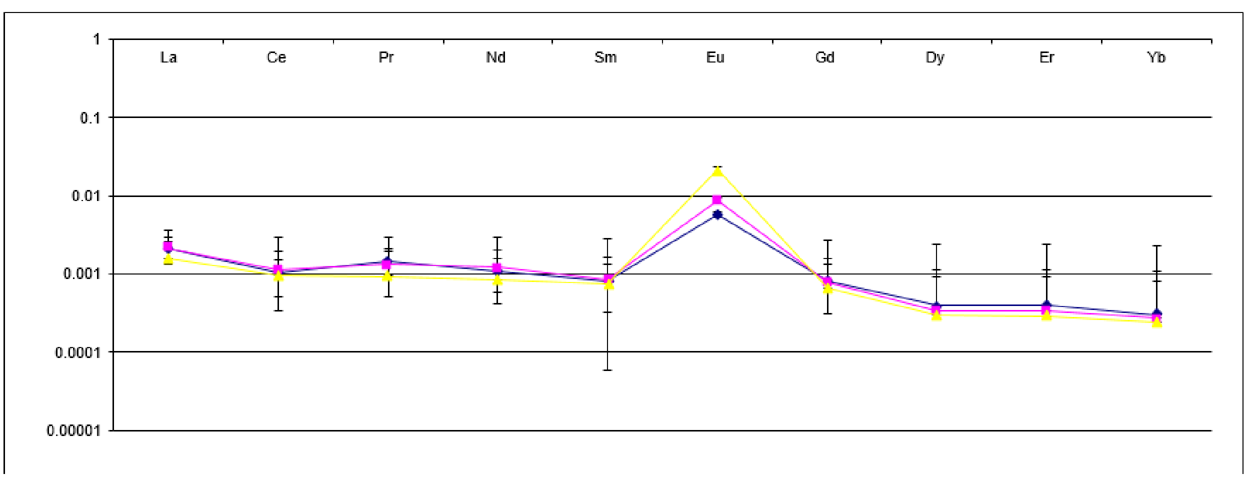
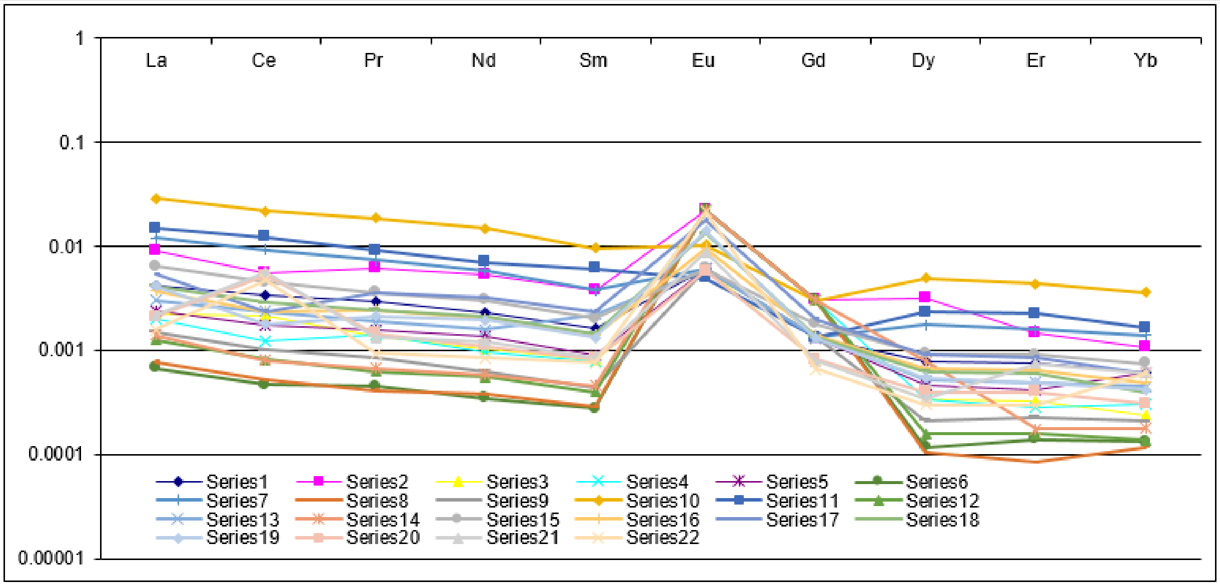


Figure 4.20: REE Chondrite normalized for Confluences of all wade's sample, Y axis represent REE Chondrite Normalisation



Legend										
Series1 = ss1	Series2= ss2a	Series3= ss2b	Series4= ss2c	Series5= ss3a	Series6= ss3b	Series7= ss3c	Series8= ss3d	Series9 =ss3e	Series10 =ss3f	Series21 =ss7b
Series1 1=ss3j	Series12 =ss3h	Series13 =ss4a	Series14 =ss4b	Series15 =ss4c	Series16 =ss4d	Series17 =ss5a	Series18 =ss5b	Series1 9=ss6	Series20 =ss7a	Series22 =ss7c

Figure 4.21: REE normalizing for all sample to compare between, Y axis represent REE Chondrite Normalisation

From the results presented through the analysis adopted an extractable method, it is clear that the values are very low and this is because of the lack of REE source, because its according to the minerology of rock sample and sediment blocks and the geological formation there is no rock type contain high REE. Also, there is no close source to make the values rise any further. It is noted that the Eu reading is slightly different from other minerals due to the enriched Turbide sandstone in the Eu.

Table 4.6: Standard for element composition in rocks

Rare Earth Element	World Shale Average (WSA)	N. American Shale Composite (NAAC)	Upper Continental Crust (UCC)	Post Archaen Australian Shale (PAAC)
La	41	31.1	30	38.2
Ce	83	66.7	64	79.6
Pr	10.1	7.7	7.1	8.83
Nd	38	27.4	26	33.9
Sm	7.5	5.59	4.5	5.55
Eu	1.61	1.18	0.88	1.08
Gd	6.35	4.9	3.8	4.66
Tb	1.23	0.85	0.64	0.774
Dy	5.5	4.17	3.5	4.68
Ho	1.34	1.02	0.8	0.991
Er	3.75	2.84	2.3	2.85
Tm	0.63	0.48	0.33	0.405
Yb	3.53	3.06	2.2	2.82
Lu	0.61	0.46	0.32	0.433

Table 4.7: REE result for Sediment sample in ppm* 10^-4

Sample. ID	Sc	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
GA-UP-SS1	96.29	12.16	9.77	20.66	2.77	10.67	2.42	3.39	2.63	0.49	1.94	0.53	1.19	0.26	0.98
GA-UP-SS2.a	108.15	26.78	20.97	33.93	5.71	23.97	5.59	12.34	5.96	0.82	3.95	0.85	2.34	0.30	1.69
GA-UP-SS2.b	101.06	7.01	5.32	13.08	1.25	4.70	1.20	9.11	1.61	0.15	0.84	0.17	0.52	0.07	0.38
GA-UP-SS2.c	95.43	6.34	4.80	7.53	1.29	4.39	1.14	7.83	1.43	0.18	0.82	0.19	0.46	0.07	0.49
GA-UP-SS3.a	94.89	9.11	5.65	10.72	1.46	6.26	1.31	1.93	1.68	0.21	1.15	0.25	0.66	0.09	0.51
GA-UP-SS3.b	93.73	2.58	1.58	2.84	0.42	1.57	0.41	1.51	0.51	0.09	0.29	0.11	0.22	0.06	0.21
GA-UP-SS3.c	153.00	29.14	28.58	56.81	6.76	26.80	5.63	3.11	6.42	0.92	4.33	0.89	2.54	0.31	2.25
GA-UP-SS3.d	77.42	2.93	1.83	3.19	0.39	1.73	0.42	1.54	0.49	0.04	0.26	0.06	0.13	0.02	0.19
GA-UP-SS3.E	80.44	5.22	3.57	6.17	0.78	2.84	0.66	2.10	0.86	0.12	0.52	0.13	0.37	0.07	0.34
GA-UP-SS3.F	245.19	90.66	68.50	133.69	17.26	67.20	14.13	5.73	17.86	2.36	12.03	2.51	6.96	1.00	5.83
GA-UP-SS3.J	201.37	36.19	35.20	75.40	8.48	31.72	8.96	2.78	7.98	1.03	5.68	1.19	3.59	0.41	2.64
GA-UP-SS3.H	89.00	4.36	3.00	4.97	0.58	2.53	0.59	1.98	0.70	0.09	0.39	0.06	0.25	0.00	0.22
GA-UP-SS4 a	120.53	9.88	7.19	14.37	1.74	7.28	3.26	3.06	1.97	0.22	1.28	0.28	0.79	0.11	0.72
GA-UP-SS4 b	86.35	4.81	3.30	4.88	0.62	2.69	0.68	1.81	0.87	0.08	0.42	0.09	0.28	0.03	0.29
GA-UP-SS4 c	112.77	20.28	15.02	27.72	3.31	13.68	2.99	3.13	3.53	0.45	2.27	0.47	1.45	0.22	1.20
GA-UP-SS4 d	101.66	14.64	8.81	14.55	2.25	9.19	2.08	5.36	2.76	0.33	1.63	0.39	1.03	0.15	0.78
GA-UP-SS5.a	85.65	18.19	12.65	14.39	3.27	14.63	3.52	10.12	3.93	0.44	2.28	0.51	1.38	0.17	0.96
GA-UP-SS5.b	93.11	13.52	9.82	17.51	2.27	9.53	2.12	7.49	2.68	0.31	1.53	0.31	0.95	0.15	0.64
GA-UP-SS6	75.68	12.97	9.80	10.88	1.99	8.86	1.96	7.90	2.60	0.25	1.34	0.27	0.78	0.09	0.67
GA-UP-SS7.a	78.50	8.40	4.92	6.31	1.35	4.99	1.23	3.21	1.63	0.27	0.98	0.30	0.64	0.19	0.49
GA-UP-SS7.b	89.79	8.57	5.11	6.96	1.23	5.54	1.27	4.90	1.56	0.16	0.85	0.21	0.56	0.05	0.44
GA-UP-SS7.c	88.90	6.50	3.74	5.80	0.87	3.87	1.13	12.02	1.31	0.11	0.74	0.14	0.47	0.05	0.39

Table 4.8: Ce/Ce*, Eu/Eu*, La/Sm*, Gd/Yb* and Ce/Yb* for sediment sample

Sample ID	Ce/Ce*	Eu/Eu*	(La/Sm)n	(Gd/Yb)n	(Ce/Yb)N
GA-UP-SS1	0.78	1.43	2.52	2.17	5.53
GA-UP-SS2.a	0.59	1.80	2.34	2.85	5.26
GA-UP-SS2.b	0.98	3.16	2.77	3.45	9.10
GA-UP-SS2.c	0.62	3.06	2.63	2.35	4.03
GA-UP-SS3.a	0.70	1.41	2.70	2.65	5.47
GA-UP-SS3.b	0.69	2.25	2.43	1.94	3.49
GA-UP-SS3.c	0.78	0.89	3.17	2.31	6.64
GA-Up-SS3.d	0.68	2.27	2.72	2.11	4.41
GA-Up-SS3.E	0.71	2.07	3.40	2.06	4.82
GA-Up-SS3.F	0.75	0.74	3.03	2.48	6.03
GA-Up-SS3.J	0.85	0.70	2.45	2.45	7.51
GA-Up-SS3.H	0.67	2.17	3.16	2.55	5.92
GA-UP-SS4 a	0.76	1.31	1.38	2.21	5.21
GA-UP-SS4 b	0.60	1.90	3.02	2.44	4.46
GA-UP-SS4 c	0.73	1.21	3.13	2.38	6.05
GA-UP-SS4 d	0.62	1.85	2.64	2.85	4.87
GA-UP-SS5.a	0.41	2.03	2.24	3.31	3.94
GA-UP-SS5.b	0.69	2.19	2.89	3.36	7.13
GA-UP-SS6	0.44	2.31	3.12	3.12	4.24
GA-UP-SS7.a	0.49	1.86	2.50	2.69	3.38
GA-UP-SS7.b	0.51	2.30	2.52	2.87	4.16
GA-UP-SS7.c	0.59	3.88	2.07	2.71	3.90
Average	0.66	1.94	2.67	2.60	5.25

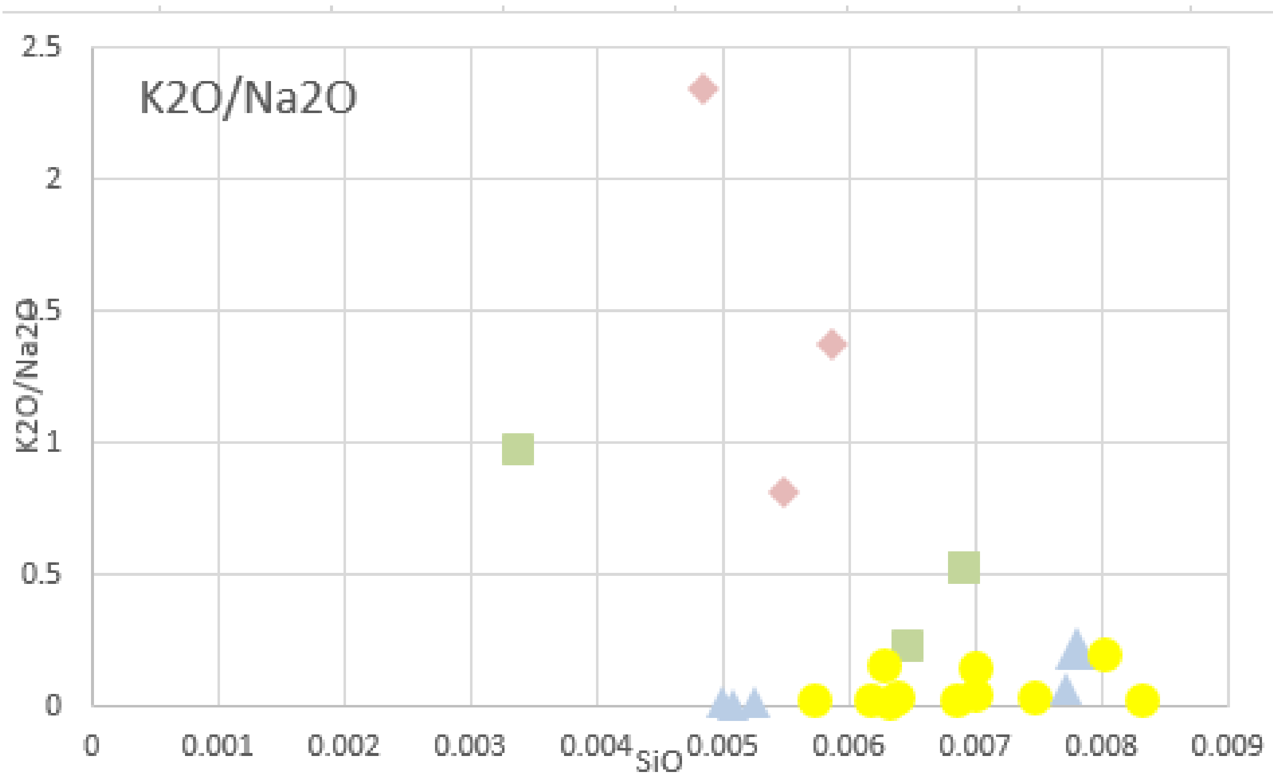
Ce/Ce* anomaly gives important information on oxidation and reduction in the surrounding environment system, results indicate positive Ce anomalies, which is ranging from (0.44-0.98) as sediments are enrichment in comparison with other REE (figure 4.21).

Eu is the last REE to alter the parity of the environment near the surface, results indicate positive Eu anomalies, which is ranging from (0.7-3.88) as sediments are enrichment in comparison with other REE. This phenomenon can be explained by the rich calcium deposits in sediments, that it considers a fertile environment for an enrichment (figure 4.21).

4.1.4.2 Major elements Plots:

Determining and specifying the origin of sediments. Several major elements were used in the form of relations between each other as diagrams. These diagrams are: 1) K2O/Na2O- SiO. 2) Geochemical classification of terrigenous sands and shales. 3) Harker diagram

1- K2O/Na2O- SiO plot:



Al-Ma’azza samp	Am greash	Arab Al-rashayda	confluences of all wadies

Figure 4.22: SiO_2 versus K_2O/Na_2O plot of Roser and Korsch (1986). subduction-related basins (ARC), continental margin arc (ACM), and passive margins (PM) are shown. Note low K_2O/Na_2O sediments of continental interior, which may be derived from a tonalitic source. Also note that the stray craton interior point that plots within the passive margin field may come from an anomalously high K_2O value. SiO_2 values are in percentages (%).

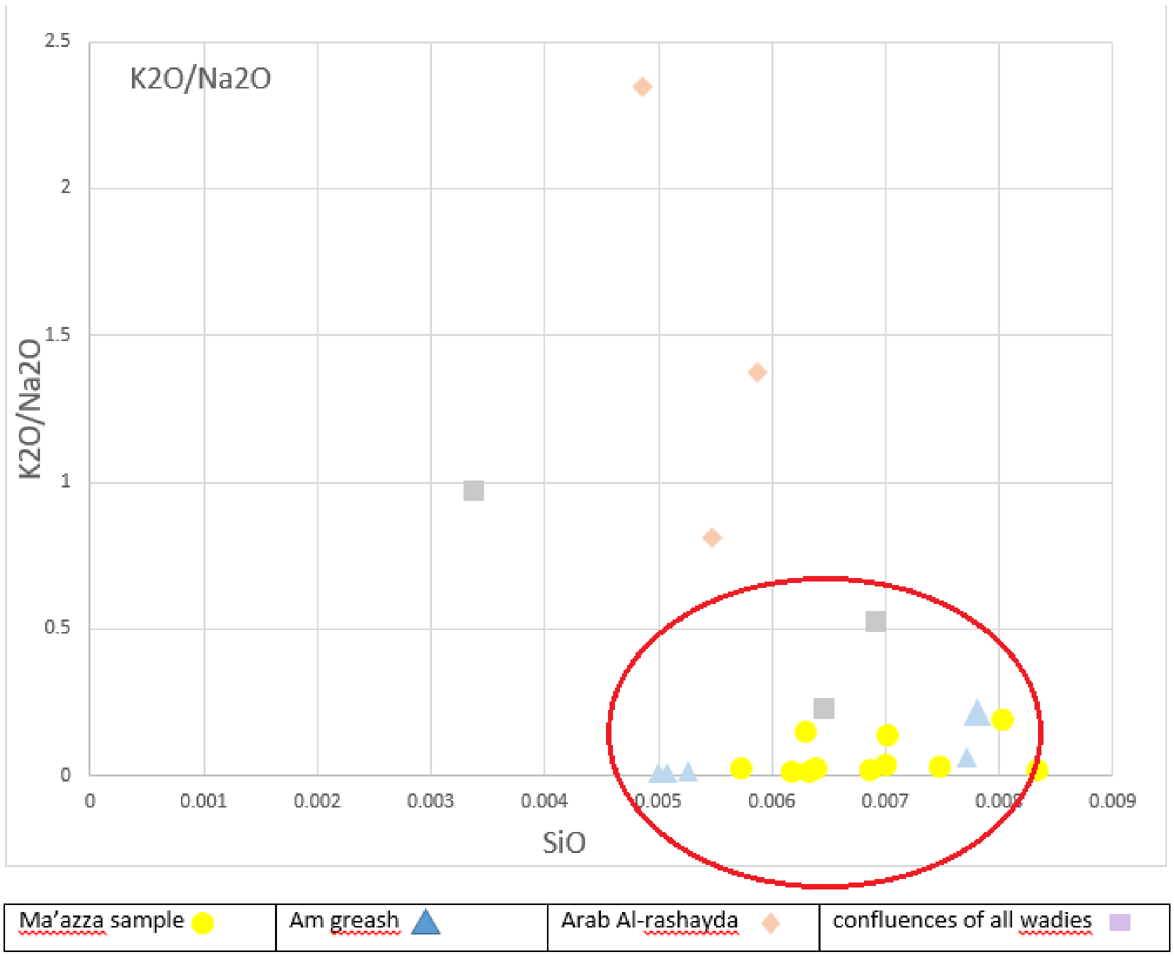


Figure 4.23: selected sediment sample that had within the range value, this sample is in the same stream

Through the attached shape, it is clear that samples in the same stream can approach each other and have approximately the same values, and this explains the transport of the elements by surface runoff and their precipitation elsewhere. Due to the low concentration of K_2O/Na_2O and SiO_2 we can support that the type of portable sediment as ARC which had poor quartz.

2- Geochemical classification of terrigenous sands and shales

For sandstone and shale classification, a scheme is used to relate chemical classifications using this scheme using SiO_2/AI_2O_3 and Fe_2O_3/K_2O ratios and available Ca concentrations either from laboratory measurements. And oil shale rich in low ratios and the proportion of sandstones and sandstone and lithium have intermediate proportions.

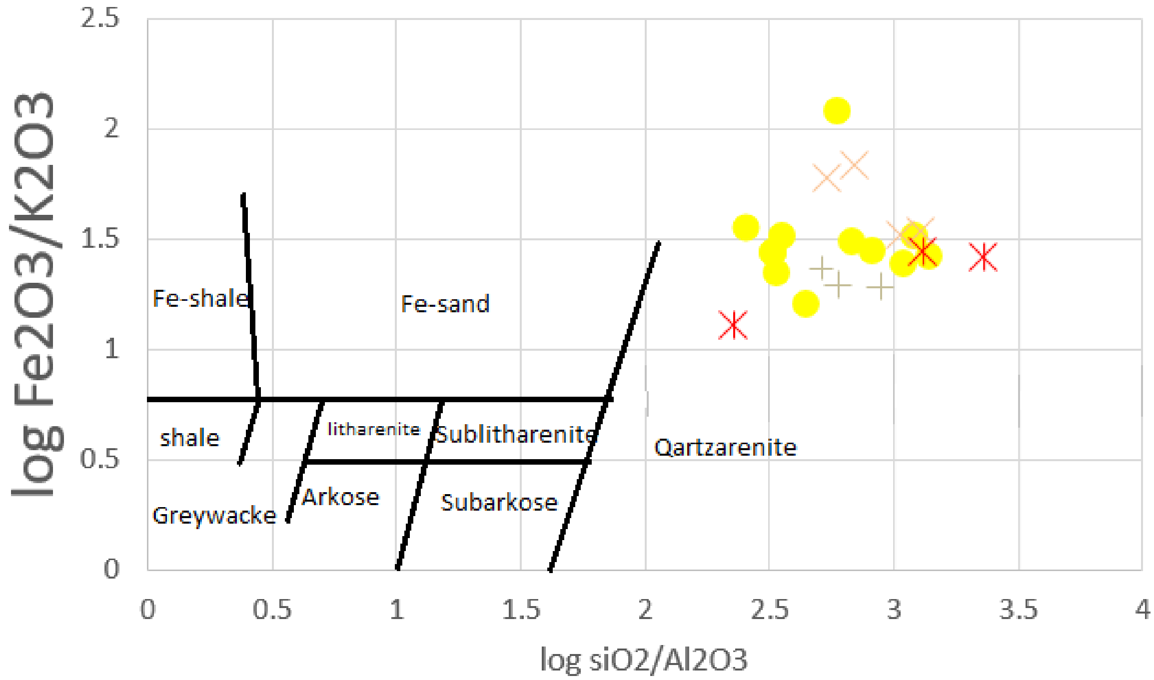


Figure 4.24: The SandClass system for geochemical classification of terrigenous sands and shales, while al ma'azza sample is O, am graesh is X, Arab alrashayda is + , and conflunces of all wadis is *.

In environmental conditions with low temperatures and pressures, feldspar, mechanics, mica, and silica are mainly formed. Fe_2O_3/K_2O_3 ratio indicates mineral stability, as sedimentary blocks that have higher stability have few ratios of Fe_2O_3/K_2O_3 and vice versa (Herron 1988).

3-Harker diagram:

It can be used to display chemical differences in a useful way. Hacker Diagram, which is considered the scheme of chemical differences, can be used, where the oxides of the major elements can be presented against SiO. Which determines the enrichment of silica in general as can be seen in all the available values, the decrease in silica rate. Low silica values denote Arcs, sandstone is considered a type of Arc is based on QFL QmFLt diagram

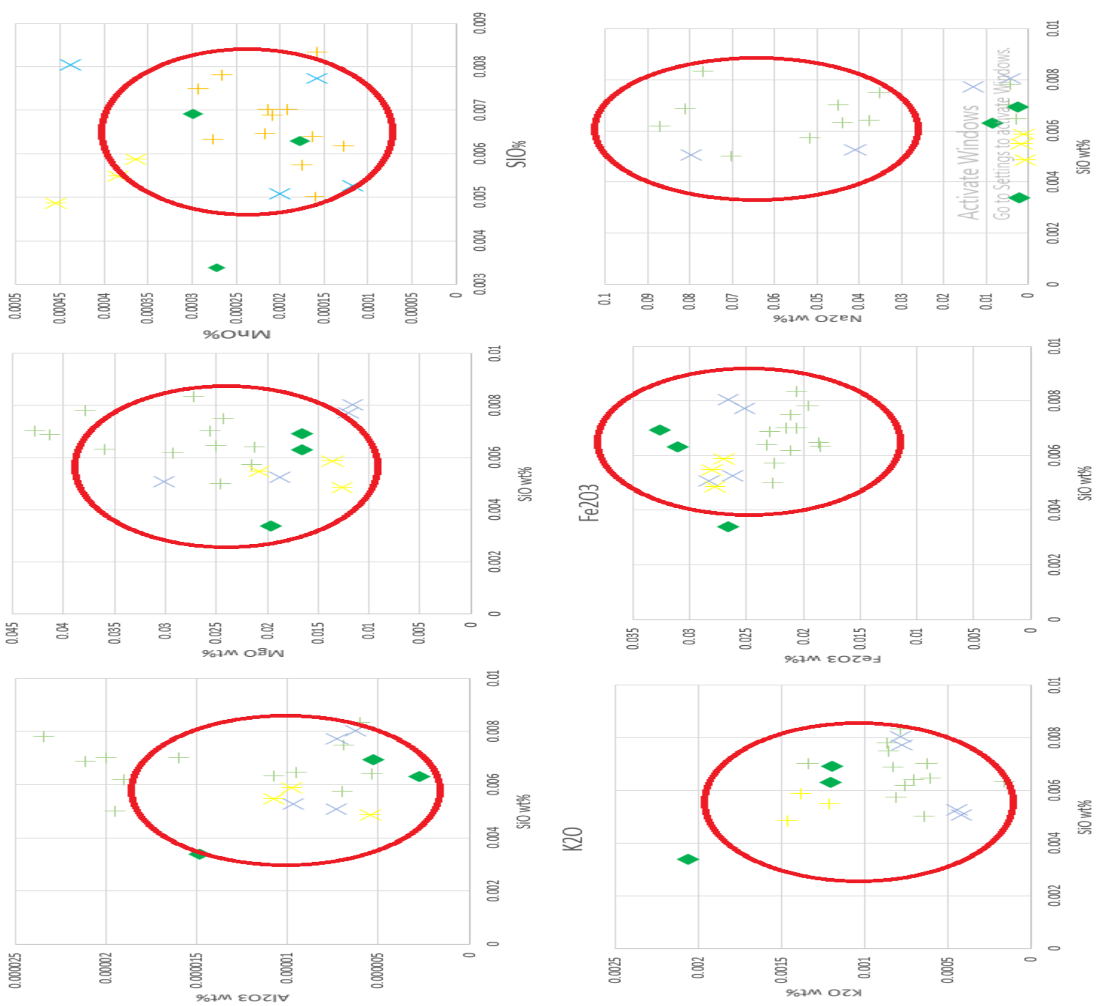


Figure 4.25: Harker diagram, represent oxide of major elements Vs. SiO for sediement sample

4.1.4.3 Trace Elements Plot:

1- Sc-V plot:

The attached figures explain the Sc- V plot. Despite the low concentration of both vanadium and scandium, each region is distinguished by a separate group from the other by the different layers from which the samples were taken, and this shows that these two elements reside chiefly in the sandy sediments of the mafic sand, which is composed of silicates or Igneous rock and is rich in magnesium and iron, in the case of the study of the wadi, there is no source of igneous rock, therefore the focus is on silicate rocks. As the vanadium and scandium are two ferromagnesian trace elements, this indicates that the sediments are subject to re-sorting and recycling, and this causes the mafic components to break down chemically, which causes a decrease in concentrations. (Peterson 2009).

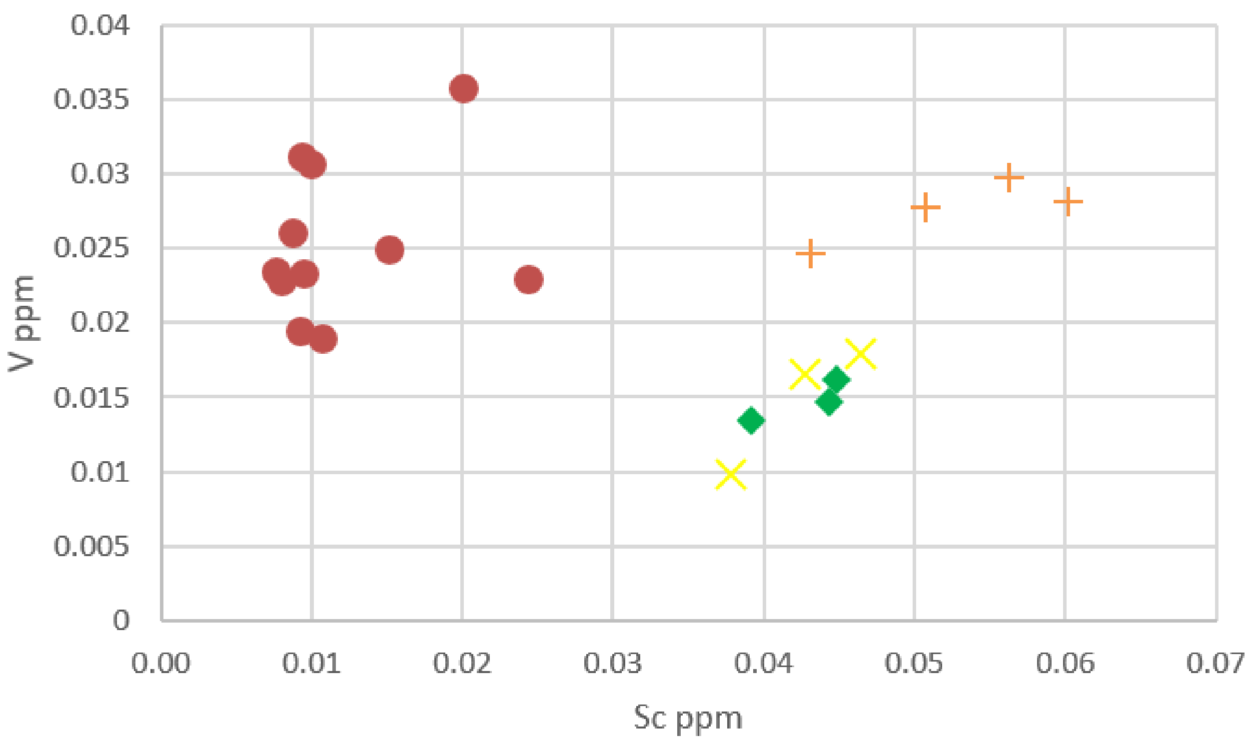


Figure 4.26: Plot of Scandium versus Vanadium (Sc-V). Where A-Ma'azza sample is O, Am greash is +, Arab alrashayda is X , and Confluences of all wadi is rhomboid.

because of the low values Very difficult to differentiate between different provenances. However, it can be observed that the samples in which rain water runs in the same stream have values close to each other

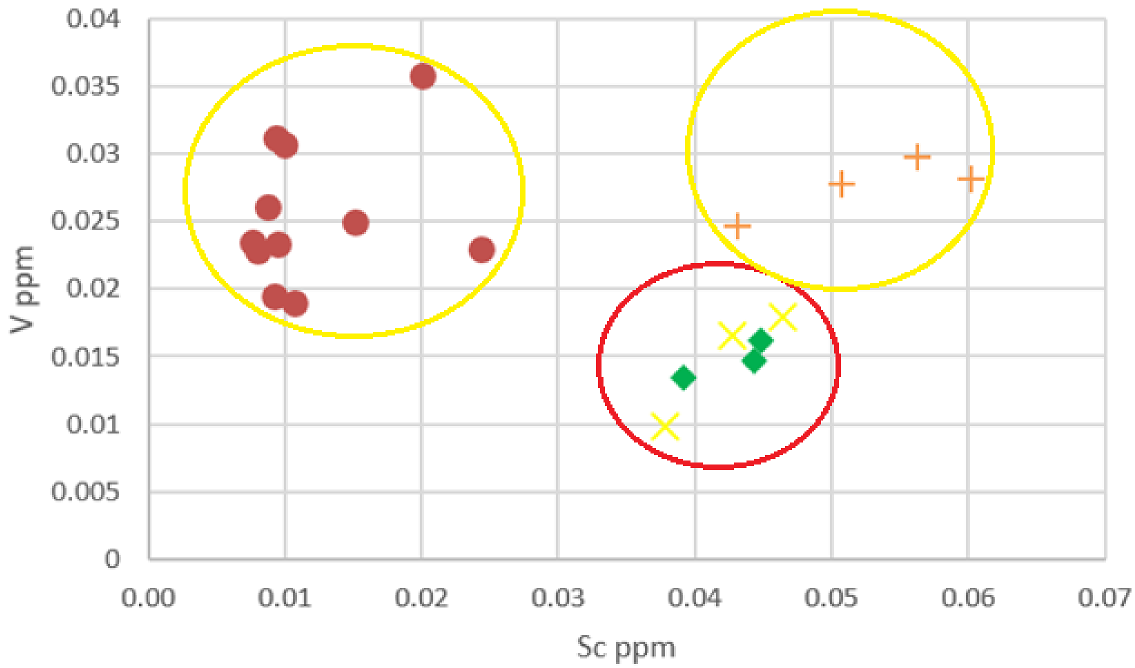


Figure 4.27: sample in the circle located near each other and had the same stream

4.2.1 Organic Carbon and Total Nitrogen:

Concentrations of organic carbon (TC) and total nitrogen (TNb) play an important role in distinguishing between land or marine sources, weather conditions that affect the soil, as well as soil quality in terms of pollution, quality and sedimentation conditions. (Avramidis et al 2015)

total organic carbon (TOC) and total nitrogen (TNb) Is considered as a source of my information is important for assessing the environmental condition of the land in the wadi, where the proportions indicated in the sediments on the presence of decomposition of plants, animals or plankton or human sources, such as chemical contaminants or fertilizers or organic waste rich (Avramidis 2015). Most sedimentary rocks and carbonate deposits consist of three components: 1- Organic materials 2- Carbon minerals 3- Non-carbon materials

4.2.1.1 Total Nitrogen:

The percentages of total nitrogen in organic matter contribute to understanding the nitrogen cycle and its history. It usually arises in two ways: internal sources (microorganisms, sediments) and external sources (industrial liquid waste, precipitation, runoff, and soil filtration), where it explains the rates of pollution in the sediments. Nitrogen can be influenced by the mineralization process that converts organic nitrogen to inorganic nitrogen by microorganisms (Wang 2018). The higher values in the two samples (GA-UP-SS3d, GA-UP-SS4d) are due to the transport of surface runoff loaded with sediments that are saturated with nitrogen from the areas adjacent to the wadi due to the use of fertilizers in the agricultural lands. It is noted that the relationship between the two samples is the height above the level of the stream where GA-UP-SS3d: 320 cm, GA-UP-SS4d: 350 cm.

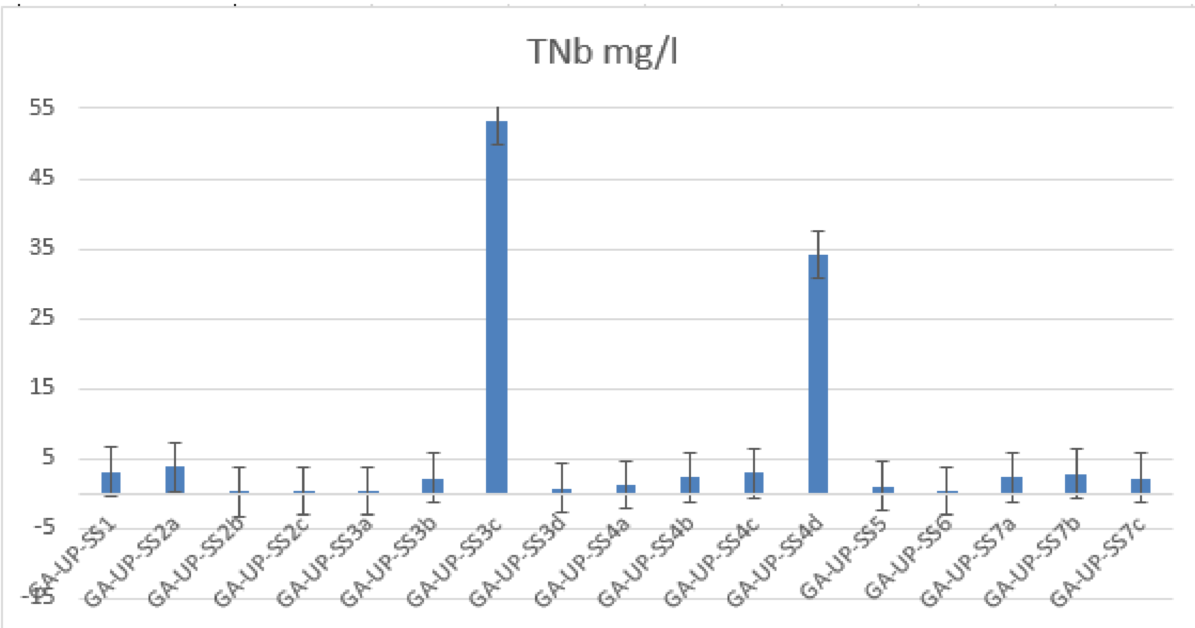


Figure 4.28: Total Nitrogen bond value for sediment sample

4.2.1.2 TOC (available):

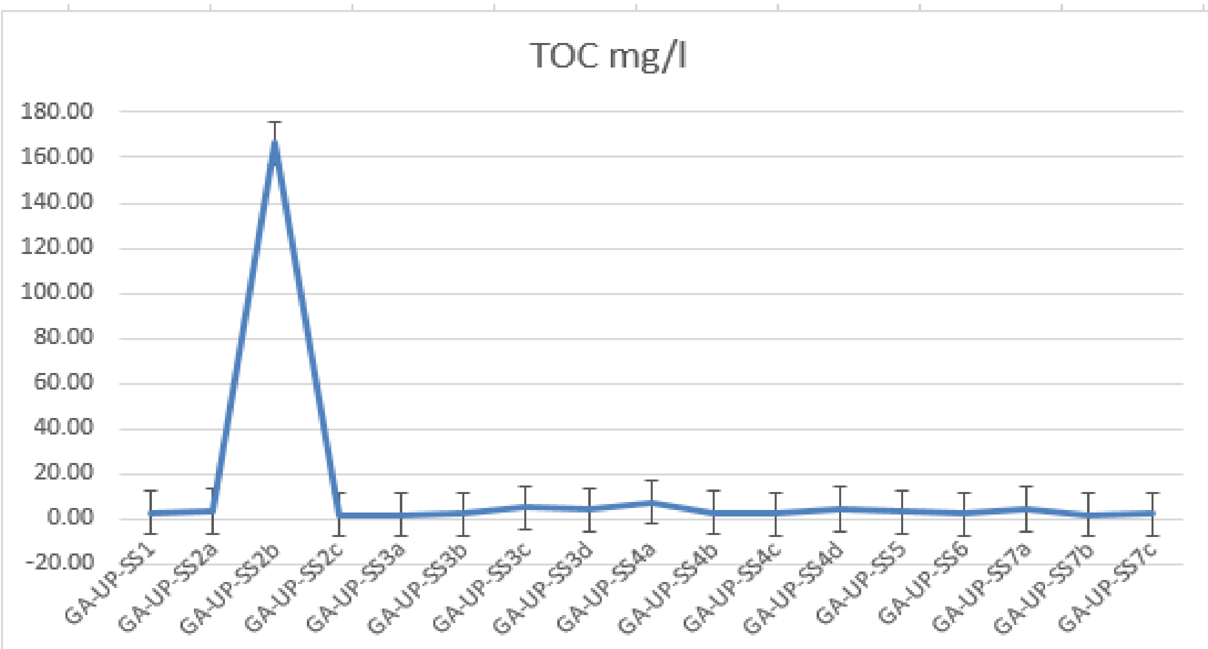


Figure 4.29: TOC value for soil sediments. It is noticeable that the sample GA-UP-SS2b is very high compared to other samples, which can be explained by the presence of animals and people living near this point where they graze sheep.

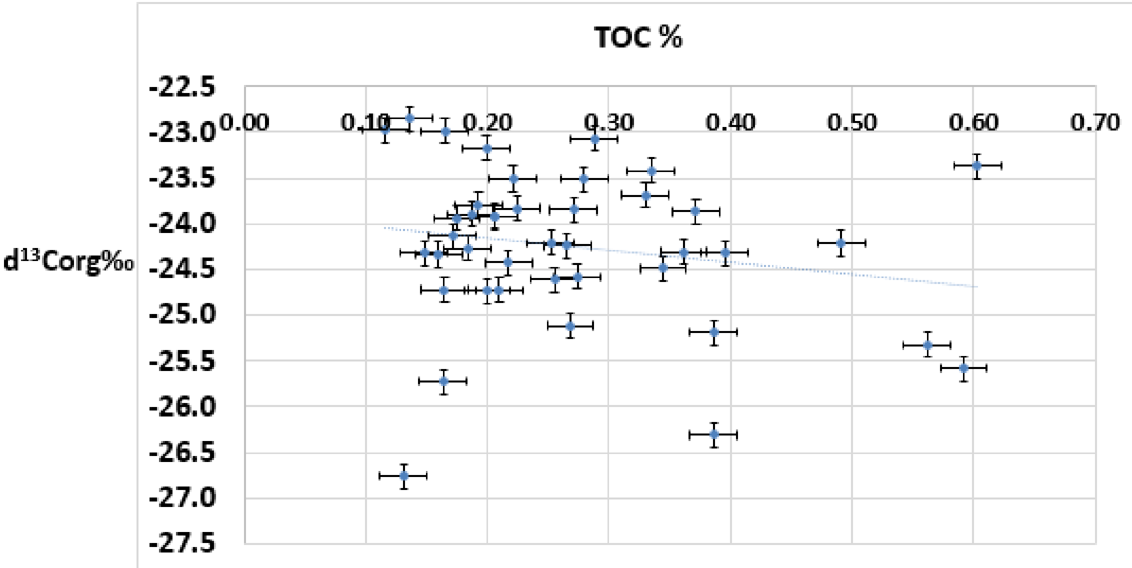


Figure 4.30: TOC% plotted versus d13C in attempt to fractionate the TOC source, it's clear that the organic carbon distributed over the study area with an increase in the d13Corg‰ indication variable organic sources (as human waste, agricultural activities).

d13C is considered as a source of organic carbon and organic matter in sediments and an indicator of climate change in the past, and its values vary based on the surrounding effects such as carbon inputs from plants and secondly through biodegradation processes. The isotope fertilization increase depends mainly on the degree of decomposition, which is controlled by climate (temperature, precipitation). The total organic carbon has a quality indicator that shows whether it is high value or low, as it is considered high >5%, low <1%. From the attached figure above, the values of the total organic carbon are low due to the lack of vegetation and the presence of people and animals in the wadi, only in the sample number is considered very high, because it is located in the first wadi where Bedouin people live close to them and graze livestock.

4.2.1.3 C:N ratio

C:N ratio is used to measure the source of terrestrial particles and the fate of organic matter in the water environment, and it enables us to distinguish the origins of pollutants related to sedimentary organic matter. Generally the value of C/N ratio for organic matter of soil 8–20 (Nasir, A.2016). Where the relationship between TOC and TIC is a negative relationship and this thing may indicate the differences in climatic conditions and soil properties that affect the various processes in conjunction with the conversion and accumulation of each. Carbon, carbonate, calcium, and magnesium are the main elements in the precipitation of carbon. Its solubility is mainly related to high TIC stock. This explains the significantly higher results For TIC. To distinguish the carbon sources in the sediments, the relationship C/N plotted versus d13C, was used (figure 4.29). Which is the ratio of the weight of total organic carbon (% TOC) to total nitrogen (% TN).

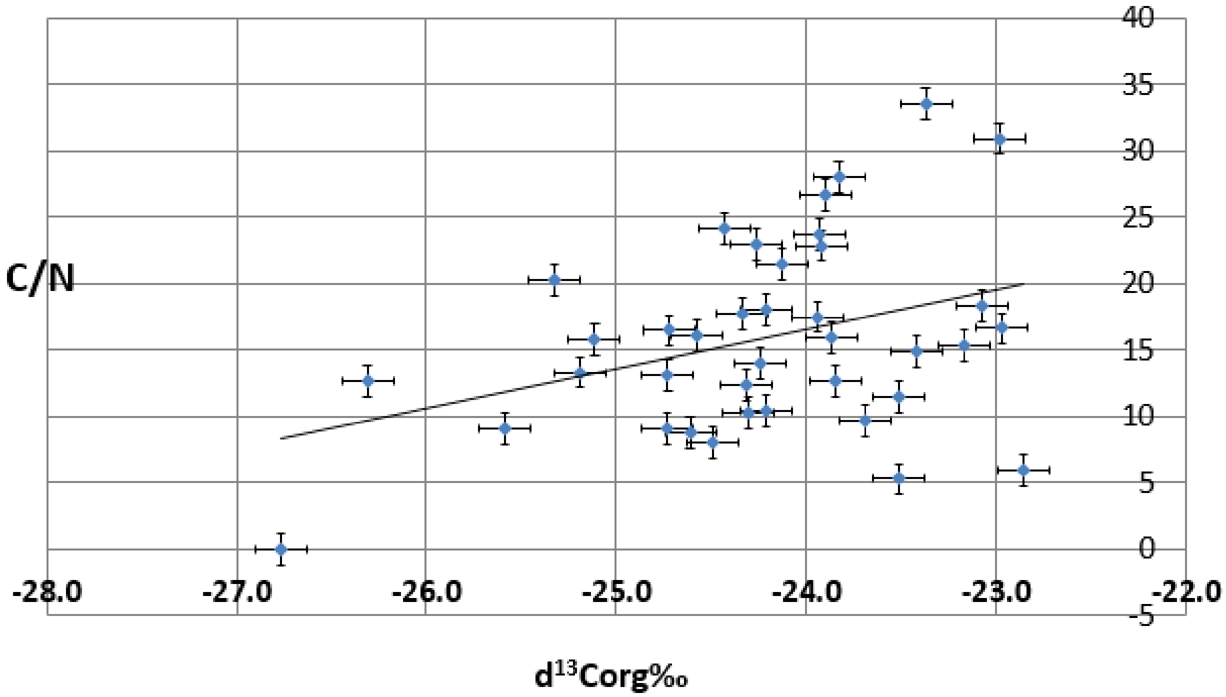


Figure 4.31: C/N plotted versus d13C as indicators for sediment sources at Al-Gar wadi to be used as an applicability of d13C and C/N as indicators for sources of organic matter.

This curve shows the relationship C/N and d13c, which is an inverse relationship that denotes the oxidation of organic matter. Due to the lack of animal and vegetable tender at the place of sampling, the values are attributed to the fact that the fresh materials are coming and loaded with the sediments transported from the agricultural lands in the neighboring areas that use the organic materials and fertilizers that raise the values of the results.

Table 4.9 : TIC, TC, TN, TOC, $CaCO_3$ value for sediment sample, value in% and C/N ratio.

Sample name	C/N	TIC %	TOC%	TN %	TC %	$CaCO_3$%
GA-UP-SS1	15.98	4.44	0.37	0.02	4.81	37
GA-UP-SS2 a	12.35	4.00	0.39	0.032	4.40	33
GA-UP-SS2 b	11.48	7.01	0.28	0.02	7.29	58
GA-UP-SS2 c	18.37	3.77	0.29	0.01	4.05	31
GA-UP-SS3 a	23.70	4.48	0.21	0.01	4.68	37
GA-UP-SS3 b	n.d	5.94	0.19	n.d.	6.13	49
GA-UP-SS3 c	5.30	3.88	0.22	0.04	4.10	32
GA-Up-SS3 d	20.31	3.21	0.56	0.03	3.77	27
GA-UP-SS4 a	33.49	7.50	0.60	0.018	8.10	62
GA-UP-SS4 b	n.d	6.44	0.16	n.d.	6.59	54
GA-UP-SS4 c	n.d	5.62	0.15	n.d.	5.77	47
GA-UP-SS4 d	30.91	4.99	0.17	0.01	5.15	42

4.3 Isotopes O^{18} and C^{13} Contents:

The contents of the isotopes were studied in order to understand the origin of the sediments. The analysis was done in Germany GFZ laboratories for the samples taken the first time. We were unable to analyze it again for the second time samples.

Studying of the isotope d13Ccarb is a very important process for understanding the method of carbon transformation because it is used as a tracer of the important biogeochemical changes taking place in the region. It is also important to argue that the significant changes that occur mainly affect carbon and its isotopes. It was suggested a decrease in the concentrations of organic carbon and d13Corg value due to the increase in the percentage of calcite present or dolomite percent. This matter can be observed when determining the types of soil present based on the studies of the sediments we carried out and the main elements that were analyzed in the calculating system. (Oehlert et al 2014)

(Gat 1984) showed that the ratios of the d18O‰that reach the Dead Sea from the area of Ein Gedi due to floods, their composition ranges from -4.7% to - 5.1% over the years. She also explained that the isotope of oxygen is greatly affected by weather factors such as heat and humidity, and this increases the negative results. This largely explains our results.

(Hudson 1977) He determined the specific values of the isotope carbon from the soil weathering processes ($\delta^{I3}C$ near —10%). Whereas the isotope is oxygen, it increases (negatively) in the circumstances in which it is low salinity and high Temperature. And that's clear in sample GA-UP-SS4.d. according to PDB standard the carbon and oxygen isotope values show that it was formed in the soil type limestone and calcite.

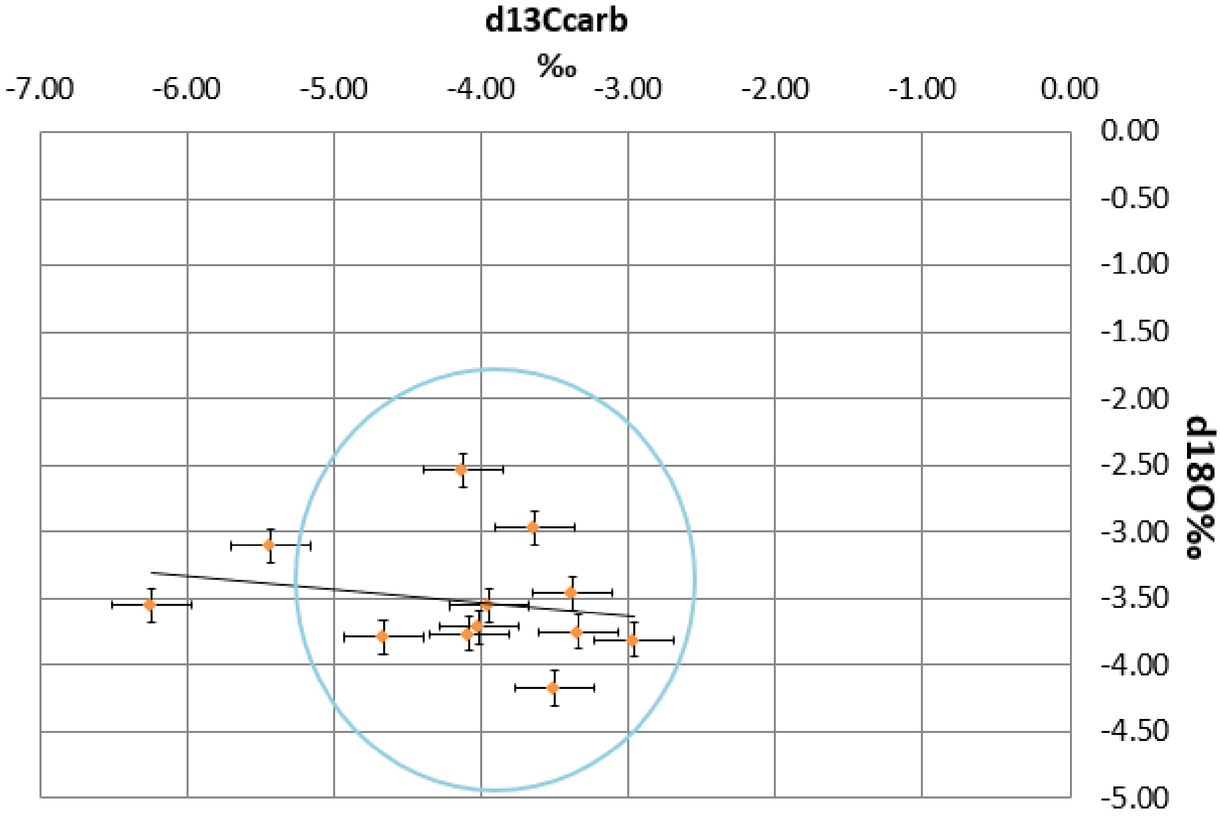


Figure 4.32: d18O plotted versus d13Ccarb

Table 4.10: Sediment isotopes percentage result, the sediment were analyzed at Germany GFZ laboratory in may 2017.

		12.05.2017		5/15/2017		Mean	Mean	
Sample name	GPS	d13C‰	d18O‰	d13C‰	d18O‰	d13C‰	d18O‰	Stdev.
GA-UP-SS1	-------------------	-6.07	-4.02	-6.41	-3.09	-6.24	-3.55	0.66
GA-UP-SS2 a	0712567/3487622	-5.49	-3.27	-5.37	-2.94	-5.43	-3.11	0.23
GA-UP-SS2 b	0712566/3487622	-4.35	-3.79	-4.99	-3.79	-4.67	-3.79	0.00
GA-UP-SS2 c	0712567/3487630	-4.31	-3.87	-3.86	-3.67	-4.08	-3.77	0.14
GA-UP-SS3 a	0713062/3487341	-3.49	-2.86	-3.79	-3.08	-3.64	-2.97	0.15
GA-UP-SS3 b	0713062/3487337	-3.49	-3.47	-4.41	-3.64	-3.95	-3.55	0.12
GA-UP-SS3 c	0713062/3487334	-3.45	-3.33	-3.32	-3.60	-3.38	-3.46	0.19
GA-Up-SS3 d	0713062/2487338	-4.02	-2.84	-4.22	-2.23	-4.12	-2.54	0.43
GA-UP-SS4 a	0715344/3487221	-4.74	-3.95	-3.29	-3.48	-4.02	-3.72	0.34
GA-UP-SS4 b	0715344/3487221	-3.09	-3.82	-2.84	-3.80	-2.97	-3.81	0.01
GA-UP-SS4 c	0715344/3487221	-3.02	-3.60	-3.66	-3.90	-3.34	-3.75	0.21
GA-UP-SS4 d	0715344/3487221	-3.66	-3.94	-3.35	-4.41	-3.51	-4.17	0.33

Chapter five:

5.1 Conclusion based to objectives :

The quantities of runoff that effect the wadi, move sediments and transfer them from one place to another, which causes the morphological shape change of the wadi. This processes is done by varies effects which are erosion, temperature, and runoff affect the sedimentary masses, by break them up into small particles, and arrange them into new beds. Weathering factors on sediments were studied to understand their effect, it was observed that CIW and PIW ratio had a positive index and not allowed to Al mobility, counter to WIP ratio which is had a negative index and allow Al to mobility. This lead to transport trace elements and major elements carried on surface runoff to other places. Surface runoff does not carry Rare earth elements, moreover, the study area does not contain sources for REE, and the majority of the rocks distributed in the area are limestone which is carbonate sedimentary rock, contain as general calcite and aragonite. Where the geological layers spread in Palestine date back to the two eras, Holocene and Pleistocene, while in Late Cretaceous era silicate metamorphic rocks were formed the marble, Marl, poplar, Dolomite rocks, and flint rocks These geological layers that cover the study area in the first geological periods. The type of soil that each geological formation which is known as sedimentary rocks possesses supports the analysis made by trying to determine the type of rock present in the area. This explains why the Mineral Element and the Element of Element are very high in the wadi as Ca, Mg, Na, and Si. The origin of the sediments present in the study area is from the sedimentary rocks that exist previously, where the sediments travel through the region, and relatively few proportions of sediments can be moved to the next area in the wadi. Weather factors such as temperature, humidity, and low salinity affect the isotopes of oxygen by increasing (negatively), while results show that the ratios of d18O reach to the Dead Sea from the Ain Gedi area due to flooding, their composition ranges from -4.7% to - 5.1% over the years. This confirms the transfer of sediments to the Dead Sea, moreover the values of isotopes of oxygen and carbon show that they were formed in the type of limestone and calcite and the study area is rich in them. In this study, high TIC values explain the abundance of the basic elements responsible for carbon precipitation which is Ca, $CaCO_3$, Mg, and K.

5.2 Recommendation:

After continuous fatigue and persistent studies for two years of field and laboratory work and observations, several recommendations will be presented to collect more accurate data for analysis and produce better studies and results.

1. It is recommended that a weather station be installed to monitor climate change and take surface run-off samples during the flash floods period.
2. Create a runoff database for continuous periods to monitor erosion and sediment transport operations in the wadi
3. Install rainwater collection stations to measure precipitation amounts and analyze their chemical and physical properties.
4. In future studies, a continuation of scientific surveys of sediments along the course of the wadi to determine the characteristics of sediments and their methods of transmission
5. Future studies should be longer and include more samples and comparison with previous readings
6. Taking samples from the heart of the Dead Sea and comparing them with the results that we obtained to make sure that the sediments can be transferred from the first wadi to the Dead Sea

5.3 Appendices:

Trace element name and symbol

Trace element		
Sodium	Na	23
Magnesium	Mg	24
Aluminium	Al	27
Potassium	K	31
Calcium	Ca	43
Vanadium	V	51
Chromium	Cr	53
Manganese	Mn	55
Iron	Fe	56
Cobalt	Co	59
Tellurium	Te	52
Caesium	Cs	55
Boron	B	5
Thallium	Tl	81
Bismuth	Bi	83
Copper	Cu	29
Lithium	Li	3

Silicon	Si	14

Rare earth element REE:

Lu	Lutetium	71
Yb	Ytterbium	70
Tm	Thulium	69
Er	Erbium	68
Ho	Holmium	67
Dy	Dysprosium	66
Sc	Scandium	21
Y	Yttrium	39
La	Lanthanum	57
Ce	Cerium	58
Pr	Praseodymium	59
Sm	Samarium	62
Nd	Neodymium	60
Eu	Europium	63
Gd	Gadolinium	64
Tb	Terbium	65

Multiply	By	To obtain
millimetre (mm)	0.03937	Inch
centimetre (cm)	0.3937	Inch
meter (m)	3.281	Foot
kilometre (km)	0.6214	Mile
square kilometre (km2)	0.3861	square mile
cubic meter per second (mVs)	35.31	cubic foot per second
gram (g)	0.002205	Pound
kilopascal (kPa)	0.1450	pound per square inch
degree Celsius (°C)	1.8, then add 32	degrees Fahrenheit

Range of water holding capacity for different soil textures:

Table 2: soil water holding capacity (in/foot) according to soil type

Textural class	Water holding capacity (inches/foot)Of soil
Coarse sand	0.25-0.75
Fine sand	0.75-1.00
Loamy sand	1.10-1.20
Sandy loam	1.25-1.40
Fine sandy loam	1.50-2.00

Silt loam	2.00-2.50
Silt clay loam	1.80-2.00
Silt clay	1.50-1.70
Clay	1.20-1.50

Table 3: Runoff curve numbers for arid and semiarid rangelands:

Cover description		Curve number for hydrologic soil group			
Cover type	Hydrologic condition[2/]	A[3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor Fair Good		80 71 62	87 81 74	93 89 85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor Fair Good		66 48 30	74 57 41	79 63 48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor Fair Good		75 58 41	85 73 61	89 80 71
Sagebrush with grass understory.	Poor Fair Good		67 51 35	80 63 47	85 70 55

Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, paloverde, mesquite, and cactus.	Poor Fair Good	63 55 49	77 72 68	85 81 79	88 86 84

- ✓ Average runoff condition, and I_a, = 0.2C. For range in humid regions, use table 2-2c.
- ✓ Poor: 70% ground cover.
- ✓ Curve numbers for group A have been developed only for desert shrub.

Group A: these soils are characterized by their low impact on surface runoff when they are wet, with water moving freely through them. Consisting of 90% gravel and sand and only 10% clay, some soils having loamy sand, sandy loam, loam or silt loam textures can contain mud if combined well, low-density, or have more than 35% rock fragments. Non-permeable waterproof layers form at 50 cm high and have a hydraulic connection of 40.0µm/second (USDA-NRCS2004).

Group B: these soils have a low potential for surface runoff if they are wet, through which the water passes unhindered. Sand is about 20% of the components of this group and about 20-90% of clay sand or silt sand and has loamy sand or sandy loam textures. It can contain mud and clay of low density if it is well formed and has more than 35% rock. An unopened layer consists of a height of 50 cm. It has a hydraulic connection of (10-40) µm/ second (USDA-NRCS2004).

Group C: this soil has a moderately high potential for surface runoff if it is completely wet, restricting water flow through it. Sand is about 20-40% of the components of this group and less than 50% clay sand have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. It can contain mud and clay of low density if it is well-formed and possesses more than 35% rocky rock. An unopened layer consists of a height of more than 50 cm. It has a hydraulic connection of (1-10) µm per second (USDA-NRCS2004).

Group D: these soils have high potential for surface runoff if they are completely wet, severely restricting water flow. Sand forms about 50% of the components of this group and have clayey texture sand more than 40% of the clay. The non-permeable layer consists of a height of less than 50 cm. It has a hydraulic connection of 1.0 µm/ second (USDA-NRCS2004).

Shear Stress:

One of the effects that affect runoff in the stream is shear stress which Works as a resistor to maintain the soil from eroding. Which Soil that has more voids has less power of shear stress.

$$u(z) = (u^*/k) \ln (z/z_0)$$

$$= (522.36\ ft/sec/0.4) \ln (415/1.540) = 7308.464262$$

Where:

- ✓ U: Velocity at elevation z
- ✓ Z_0: the roughness height.
- ✓ K: is von Karman’s constant (generally set to 0.4)
- ✓ Z: elevation above the bed

$$\tau = \rho U^{2*}$$

$$\tau = \rho g h S_f$$

$$7308.464262 = \rho * 9.8 * 1.5 * 0.02$$

$$\rho = 24858.72\ g/ml$$

- ✓ ρ: fluid density
- ✓ *G:* is the gravity constant 9.8 m/s/s
- ✓ H: is the water depth
- ✓ S_f: is the friction slope

Hydraulic shear stress is the main control of the transportof molecules in running water, which this factor that influence it: (1) Organic matter determines the binding of soil parts to each other ; (2) Arrange and size of sediment in the bed stream where it affects the force of friction; (3)

Vegetation and presence of roots. Shear stress can be affected by the characteristics of soil in the area such as organic matter, density and soil texture (Léonard, J., & Richard, G. (2004))

Darcy–Weisbach Equation:

$$\tau=(1/8)\ (\rho f U^2)$$

$$7308.464262 = (1/8)\ (\rho*0.00000126*522.36^\wedge 2)$$

- ✓ U: flow velocity
- ✓ S_f:head loss gradient
- ✓ ρ: fluid density
- ✓ ***F*: 64/Re= 64/***50902373

- **Viscosity:**

$$\mu = 0.0168 * p*T -0.88$$

$$= 0.0168*24858.72 *12-0.88=5010.64\ cP$$

$$=5.01\ Pa.s$$

Where:

- ✓ μ = Viscosity [cP]
- ✓ p= density [kg/m^3]
- ✓ T= Temperature [°C]

Predict the resistance of runoff which is being deformed by either shear stress or tensile stress, where it is refer to thickness of fluid

Darcy's Law: it's the definition of PERMEABILITY

$$Q= (-KA(P_b-P_a))/(\mu L)$$

$$29661.81185\ m^3/s=(-\ 1.540*240(47983\rho gh-Pa)/(5.01*35000\ m)$$

$$Pa= -0.0000014073$$

Which is Represent the final pressure in Pa

Where:

- ✓ Q= total discharge in m3/s
- ✓ K= Soil coefficient of permeability m^2
- ✓ A= Cross sectional area of flow in m^2
- ✓ P_b= initial pressure in Pa
- ✓ P_a= final pressure in Pa
- ✓ μ= Viscosity in Pa
- ✓ L= length in m

P: pressure in Pa = weight/ Area = volume of flow/ Area= (94176 m^3/19.627) = 47983ρgh Which is Represent the initial pressure in Pa

Velocity:

$$V= -K* (p/p_0 * \nabla h + \nabla z)$$

Where:

- ✓ K: The hydraulic conductivity
- ✓ P: is the water density
- ✓ P_o: is the referenced water density at zero chemical concentration
- ✓ Z: is the potential head
- ✓ h: is the pressure head

Mean boundary shear stress

Resisting force (Fo) = boundary shear stress * total bed area

*=5672.58 *240 Km^2= 1361419.2*

Predict the soil body force of resistance opposite the transportof runoff

The Rational Formula is expressed as:

$$Q= (C)\ (i)\ (A)$$

- ✓ Q= peak rate of runoff in cubic feet per second (cfs)

- ✓ C= runoff coefficient, a dimensionless unit
- ✓ I= average intensity of rainfall in inches per hour (in/hr) which is:

Intensity of rainfall = Depth of rainfall /Time

= 392.4 mm/4 h= 98.1 mm/h

This values shows the rainfall intensity in baniNaim area according to Palestinian meteorological station department data 2014.

- ✓ A= the watershed area in acres (ac) = 61776.3

Q= (240)(98.1)*(61776.3) = 1454461207.2 (cfs)*

Discharge quantity:

*Q= K*A*(h/I)*

*= 2.5*186.3* (0.56/5.4)= 48.3*

- ✓ Q: discharge
- ✓ K: hydrolic conductivity
- ✓ A: area
- ✓ H: high
- ✓ L: length

/

Estimating Evaporation Rate:

- Latent heat of vaporization: is the heat given up during vaporization of liquid water to water vapour:

$$l = 2.501*10^{6} - 2370T$$

December 2017: *2.501*10^6 -2370*12= 2472560*

January 2018:*2.501*10^6 -2370*10.1= 2477063*

April 2018: *2.501*10^6 -2370*17.4= 2459762*

We predict the Latent heat of vaporization for three different month according to Palestinian metrological station data.

[Evaporation- Aerodynamic method]

B is the vapour transfer coefficient with units of mm/day-Pa

$$B= (0.102u_2)/ [In (z_2/z_0)]^2$$

u_2= wind speed (m/s) measured at height z_2 (cm)

Z_0 is the roughness height (0.01-0.06 cm) of the water surface

$$E_{as}=611 \exp[(17.2T)/(237.3+T)]$$

$$E_{as}= 611\exp [(17.2*12)/(237.3+12)] = 1398.278 \text{ Pa } (N/m^3)$$

- ✓ E_{as} and ea have units of Pa (N/m^3)
- ✓ T is the air temperature in C

$$E_a=R_h e_{as}$$

- ✓ Rh is the relative humidity ($0 \leq R_h \leq 1$)

Evapotranspiration:

$$ET= 1/L (R_n/1+\Delta)$$

$$= 1/2459762 ($$

Where:

- ✓ ET: evapotranspiration depth per day
- ✓ R_n: net radiation
- ✓ L: latent heat vaporization
- ✓ Δ: Bowen ration= H_5/ (L)ET)

Water Balance Equation:

$$P\text{-}ET\text{-}RO = \Delta S$$

392.4 mm- ET- 6 = 0.6

ET= 385.8 mm/m

Where:

- ✓ P: precipitation depth
- ✓ ET: evapotranspiration depth
- ✓ RO: runoff depth measures at stream or river gauging station
- ✓ ΔS: change in stored water depth

To describe the water flow in and out of the channel.

Manning's equation is:

$$V = (1.49\, r^{2/3}\, s^{1/2})/n$$

$$V = (1.49 * 51.277^{2/3} * 0.02^{1/2})/0.025 = 522.36 ft/sec$$

Where:

- ✓ V = average velocity (ft/sec)
- ✓ r = hydraulic radius (ft) and is equal to **A/Pw**
- ✓ a = cross sectional flow area (ft 2)
- ✓ Pw = wetted perimeter (ft); this is the length of the portion of the cross sectional area in contact with the open channel
- ✓ s = slope of the hydraulic grade line (ft/ft)
- ✓ n = Manning's roughness coefficient for open channel flow; which is Earth channel – gravelly (0.025)

Used to estimating average velocity of runoff in open channel

OR:

$$V = Q/ A$$

$$522.36 ft/s = Q/2005.3165 ft^2$$

$$Q=1047497 ft^3 /s$$

Where:

- ✓ V = average velocity (m/s, ft/s)
- ✓ Q = flow rate (m^3 /s, ft^3 /s)
- ✓ A = area (m^2, ft^2)

Hydraulic radius (ft):

$$R= A/ Pw$$

$$=186.3/11.92 = 15.6292 m = 51.277 ft$$

- ✓ **A:** cross-sectional area (m^2, ft^2)
- ✓ **Pw:** wetted perimeter (m, ft)

We measured the area of the cross section of the wadi channel that passes the runoff

Wetted Perimeter

$$P = b + 2 h$$

$$= 10.80 +2*0.56 =11.92 m$$

We have predicted the circumference of the cross-section of the runoff stream of the "cross-section" which is known as the hydraulic radius

Using Chezy's formula:

$$C= (157.6)/ (1.81+ (k/\sqrt{m})$$

$$= (157.6)/ (1.81+ (1.540/7.161))= 77.8 m/s$$

- ✓ K= Bazin’s constant
- ✓ M= Hydraulic radius

Which expects an average flow rate velocity of steady, turbulent open channel flow.

Bazin’s constant

No.	Inside nature	K values
1	Very smooth	0.109
2	Smooth: bricks & concrete	0.290
3	Smooth: rubble masonry	0.833
4	Good, earthen material	1.540
5	Rough: bricks & concrete	0.500
6	Rough earthen material	3.170

Head loss:

$$h_L = K\, v2/2g$$

$$= 2.5 * (522.36\ ft/sec)^{\wedge}2\ /2*9.8 = 34803.6$$

k: resistance coefficient found from Darcy-Weisbach equation

Head loss causes friction between surface runoff and surface, reducing surface runoff, which causes low static pressure.

Travel time is the ratio of flow length to flow velocity:

Estimating travel time for runoff in study area

$$T_t = (L/3600V)$$

$$= (114829.4\ ft\ /3600 * 522.36\ ft/s) = 0.06106\ hr$$

Where:

- ✓ T_t = travel time (hr)
- ✓ **L** = flow length (ft)
- ✓ **V** = average velocity (ft/s)
- ✓ 3600 = conversion factor from seconds to hours

$$R = D + Ae + \Delta R$$

$$Renold's\ Number = pvd/u$$

$$=19294.49*522.36*2/0.396 = 50902373$$

This law can be guessed if it is whether fluid flow is laminar or turbulent.

Laminar > 2300> turbulent

Where:

p = density (m/l^3)

v = velocity (l/t) = *522.36ft/sec*

d = average depth of flow = 2 meter

u = viscosity (m/lt)

Estimating Infiltration Rate:

Horton Infiltration:

$$F_p = F_c + (F_0 - F_C)e^{-kt}$$

$$= 10 + (20-10)*e^{(-1*14400)} = -143963\ mm/hr$$

sediment detachment capacity

$$\mathbf{D_c = K_r(\tau - \tau_c)}$$

K_r:rill soil erodibility factor

$$T = (D_c / K_r) + \tau_c$$

SCS runoff curve number method:

$$Q = (P - I_a)2/(P - I_a) + S$$

Where:

- ✓ Q:runoff (in)
- ✓ P: rainfall (in)
- ✓ S: potential maximum retention after runoff begins (in) and
- ✓ I_a: initial abstraction (in), I_a= 0.2S
- ✓ Q = (P-0.2S)2/(P+0.8S)

  S is related to the soil and cover conditions of the watershed through the CN.

$$S = (1000/CN) - 10$$

$$I_a = \text{initial abstraction (in.)} = 0.2S$$

- Surface storage:

$$S = (1000/CN) - 10$$

$$= (1000/88) - 10 = 1.363636$$

I_a= initial abstraction (in.) = 0.2*1.363636 = 0.27273in

Where is 6.927342 mm

Initial abstraction: this term reflect to the fraction of runoff that will be done after storm started

Average permeability for different soil textures in cm/hour (FAO)

Table 4: FAO standard for average permeability according to soil type

Soil type	Average Permeability (cm/hour)
Sand	5.0
Sandy loam	2.5

Loam	1.3
Clay loam	0.8
Silty clay	0.25
Clay	0.05

Table 5: REE concentration in mg/l for sediment sample

Sample name	Sc	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
GA-UP-SS1	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS2.a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS2.b	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS2.c	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS3.a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS3.b	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS3.c	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-Up-SS3.d	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-Up-SS3.E	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-Up-SS3.F	0.02	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-Up-SS3.J	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-Up-SS3.H	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS4 a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS4 b	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS4 c	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS4 d	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS5.a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS5.b	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS6	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS7.a	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS7.b	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-SS7.c	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-L6-2604018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA-UP-L7-2604018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

GA-UP-L2012018	0.00	0.00	0.00	0.00	ND	0.00	0.00	0.00	ND	ND	0.00	ND	0.00	ND	0.00
GA-UP-L1012018	0.00	0.00	0.00	0.00	ND	0.00	0.00	0.00	0.00	ND	0.00	ND	ND	ND	0.00

Table 6: pH and EC value for all sediment sample

Sample name	pH	EC µS/cm
GA-UP-SS1	8.12	2940.00
GA-UP-SS2 a	8.85	106.30
GA-UP-SS2 b	8.59	308.67
GA-UP-SS2 c	8.52	191.37
GA-UP-SS3 a	8.45	1818.67
GA-UP-SS3 b	8.52	3813.33
GA-UP-SS3 c	8.71	1808.67
GA-Up-SS3 d	8.20	4186.67
GA-Up-SS3 E	8.68	2346.67
GA-Up-SS3 F	8.35	4026.67
GA-Up-SS3 J	8.31	5013.33
GA-Up-SS3 H	9.04	1304.33
GA-UP-SS4 a	8.23	902.67
GA-UP-SS4 b	8.05	3620.00
GA-UP-SS4 c	7.81	8516.67
GA-UP-SS4 d	8.05	592.00
GA-UP-SS5a	8.81	110.27
GA-UP-SS5b	8.54	202.53
GA-UP-SS6	8.65	99.20
GA-UP-SS7 a	8.47	416.33
GA-UP-SS7 b	8.69	190.70
GA-UP-SS 7c	8.56	141.80

Table 7: Organic Carbon and Total Nitrogen for sediment sample

Sample ID	TOC mg/l	TNb mg/l
GA-UP-SS1	2.87	3.123
GA-UP-SS2a	3.44	3.817
GA-UP-SS2b	166.64	0.140
GA-UP-SS2c	1.80	0.36
GA-UP-SS3a	1.80	0.38
GA-UP-SS3b	2.32	2.2
GA-UP-SS3c	5.07	53.30
GA-UP-SS3d	4.26	0.77
GA-UP-SS4a	7.5	1.27
GA-UP-SS4b	2.72	2.37
GA-UP-SS4c	2.45	2.87
GA-UP-SS4d	4.38	34.12
GA-UP-SS5	3.21	1.00
GA-UP-SS6	2.13	0.34
GA-UP-SS7a	4.42	2.27
GA-UP-SS7b	2	2.79
GA-UP-SS7c	2.27	2.26

Table 8: Trace element concentration for sediment sample

	Sample name	SS1	SS2.a.	SS2.b.	SS2.c.	SS3.a.	SS3.b.	SS3.c.
Li	mg/kg	0.30	0.19	0.22	0.23	0.31	0.35	0.33
B	mg/kg	3.01	0.88	1.56	1.87	6.66	18.09	8.26
Na	mg/kg	3260.85	197.49	304.51	351.63	2608.45	5699.58	3328.78
Mg	mg/kg	2173.03	1513.20	2281.83	2583.52	1467.91	1643.55	1544.24
P	mg/kg	140.74	65.03	78.02	89.34	118.55	93.14	96.68
Fe	mg/kg	1298.84	1307.83	1364.14	1440.54	1479.48	1442.79	1506.59
Te	mg/kg	Nd	Nd	0.00	Nd	0.00	0.00	Nd
Cs	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ba	mg/kg	8.98	33.45	30.24	26.32	4.92	4.80	4.68
Tl	mg/kg	Nd	Nd	Nd	0.00	Nd	Nd	Nd
Pb	mg/kg	0.02	0.01	0.01	0.02	0.02	0.02	0.02
Bi	mg/kg	Nd	Nd	Nd	Nd	Nd	Nd	Nd
Al	mg/kg	2.03	1.81	4.42	3.78	1.31	1.14	3.03
K	mg/kg	12.78	50.51	72.13	51.83	71.19	64.95	111.02
Ca	mg/kg	14161.56	13859.52	13893.67	14406.03	14471.00	14073.34	14210.94
V	mg/kg	0.23	0.19	0.31	0.31	0.31	0.19	0.25
Cr	mg/kg	0.02	0.02	0.02	0.04	0.03	0.02	0.02
Mn	mg/kg	21.34	16.82	20.58	16.54	22.73	12.24	14.84
Co	mg/kg	0.06	0.05	0.09	0.07	0.07	0.07	0.07
Ni	mg/kg	0.54	0.28	0.43	0.43	0.37	0.29	0.28
Cu	mg/kg	0.12	0.10	0.10	0.08	0.13	0.08	0.10
Zn	mg/kg	0.12	0.10	0.15	0.13	0.12	0.11	0.15
As	mg/kg	0.11	0.07	0.10	0.10	0.14	0.12	0.08
Se	mg/kg	0.08	0.02	0.03	0.03	0.07	0.05	0.04
Mo	mg/kg	Nd	Nd	Nd	Nd	Nd	Nd	Nd
Cd	mg/kg	0.10	0.02	0.04	0.05	0.07	0.10	0.06

SS5.b.	SS5.a.	SS4 d	SS4 c	SS4 b	SS4 a	SS3.H.	SS3.J	SS3.F	SS3.E	SS3.d
0.07	0.07	0.12	0.10	0.14	0.15	0.20	0.27	0.18	0.20	0.26
0.47	0.86	1.84	1.47	4.41	8.44	2.12	2.27	2.47	2.50	3.20
111.78	74.93	313.74	5914.61	3007.88	964.74	2777.44	6004.68	5218.43	3819.15	6461.95
1256.55	818.11	702.82	1822.03	1134.19	727.64	1279.31	2492.60	1480.48	1303.19	1763.86
28.13	27.98	108.69	30.96	21.89	81.83	64.28	114.38	28.83	41.26	71.47
1958.94	1892.68	1864.60	1977.74	1833.72	1763.68	1621.47	1601.87	1590.64	1581.05	1478.91
0.00	Nd	0.00	0.00	0.00	0.00	Nd	0.00	0.00	0.00	Nd
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.51	26.93	15.06	7.80	5.21	8.79	5.97	3.54	6.54	6.54	4.97
0.00	0.00	0.00	0.00	Nd	Nd	Nd	Nd	0.00	0.00	Nd
0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01
0.00	0.01	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
2.03	1.85	1.18	1.38	1.84	1.37	1.01	4.00	3.69	1.33	3.60
100.72	114.84	65.40	34.62	37.03	64.55	58.30	68.77	53.41	67.00	63.23
15054.07	15036.91	14999.14	16197.27	15691.62	15345.74	14529.70	14267.83	14499.47	14488.59	13914.06
0.18	0.17	0.28	0.30	0.25	0.28	0.26	0.36	0.23	0.23	0.23
0.02	0.03	0.04	0.12	0.07	0.03	0.03	0.06	0.06	0.04	0.05
29.70	28.16	33.92	15.58	9.16	12.25	12.70	16.11	12.34	13.56	9.93
0.10	0.08	0.09	0.13	0.06	0.08	0.09	0.08	0.11	0.10	0.08
0.41	0.35	0.28	0.55	0.30	0.36	0.38	0.53	0.37	0.40	0.32
0.08	0.08	0.11	0.08	0.07	0.12	0.07	0.08	0.08	0.08	0.12
0.12	0.13	0.15	0.18	0.10	0.13	0.15	0.14	0.16	0.16	0.15
0.04	0.04	0.12	0.10	0.08	0.13	0.11	0.11	0.08	0.09	0.07
0.03	0.04	0.02	0.10	0.10	0.05	0.05	0.09	0.07	0.07	0.07
Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
0.01	0.01	0.07	0.14	0.07	0.10	0.09	0.09	0.08	0.09	0.08

SS7.c.	SS7.b.	SS7.a.	SS6.
1.28	0.07	0.10	0.04
1.33	0.74	1.70	0.36
158.09	170.08	616.27	46.45
195.75	166.13	165.79	758.48
50.48	40.29	26.40	12.54
1863.27	2286.56	2171.78	1948.33
0.00	0.00	0.00	0.00
0.00	0.00	0.00	Nd
Nd	Nd	Nd	20.30
25.54	13.63	8.63	Nd
Nd	Nd	Nd	0.01
Nd	0.01	0.01	Nd
2.80	0.99	0.52	1.03
171.57	99.03	99.82	121.90
13311.09	16164.82	15855.04	14716.70
0.15	0.16	0.13	0.10
0.02	0.03	0.15	0.02
20.96	23.11	13.64	35.20
0.06	0.08	0.06	0.10
0.16	0.41	0.31	0.27
0.02	0.07	0.04	0.04
1.85	0.06	0.01	0.05
0.06	0.05	0.03	0.02
Nd	0.05	0.05	0.03
6.29	Nd	Nd	Nd
0.01	0.01	0.02	0.01

ND: not detected

Expermintal section:

3.1.1 Soil extract: according to SOP (CCBA-SOP-004) studying the concentration of inorganic salts (weight/volume) in the soil. 5 g air dry soil were taken that sieved at < 2mm (balance , then add up to 50 ml DI water in Erlenmeyer Flask 250 ml. Stir the suspension for 1h at orbital shaker (M.N: SI-1601, S.N: SI11601-85) and then filtrated it with round whatman filter paper.

3.1.2 pH determination for soil extract: this procedure determine whereas the soil are alkaline which is a physical indicator, basic, natural, or acid. According to SOP (CCBA-SOP-005) using Soil Extract in (CCBA-SOP-004) Step number 5.2.1. Reading were done by pH meter (HACH M.N: HQ11D, SN: 140500103285)

3.1.3 Electric conductivity (EC): this procedure describes the method for determine Soil salinity that refers to the concentration of soluble inorganic salt (weight/volume). According to SOP (CCBA-SOP-006) using soil extract in SOP (CCBA-SOP-004) Step number 5.2.1, reading were done by using EC meter (HACH M.N: HQ14d, SN: 140500103195)

3.1.4 Chloride (Cl-): this procedure determination the concentration of Cl^- in Soil extract. According to SOP (CCBA-SOP-008),10 ml of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 were transferred to 250 conical flasks then dilute it with 100 ml D.W. A few drops of Potassium chromate indicator solution ($K_2CrO_4$5% in water) were added and titrated with Standard silver nitrate solution ($AgNO_3$ 0.01N) using burette 25 ml to the end point whereas pinkish yellow. Calculated the concentration by equation in the appendix section.

3.1.5 Alkalinity (HCO_3^-):this procedure determines the alkalinity in water, soil extract. According to SOP (CCBA-SOP-009) (25-50 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 were transferred to 250ml conical flask (add 1 drop of 0.1 M $Na_2S_2O_3$ if the sample contain residual chloride). If pH is above 8.3 adding 5 drops of phenolphthalein resulting a pink color, titrated were done with standard Hydrochloric acid Solution (HCl 0.1 N) until the disappearance of the pink color or to “pH 8.3”. If no pink color was appearance 5 drops of mixed indicator were added then titrated with HCl.

3.1.6 Calcium (Ca): this procedure determines the calcium in water, soil extract as $CaCO_3$ which is the major component of hardness in water.According to SOP, (25-50 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 were transferred to 250ml conical flask then add 25ml D.W. 2ml of 2 N NaOHwas added and mixing, 2-3 drops of murexide as indicators were added and titrate using burette 25 ml with EDTA (0.01 N) to change the color to purple color.

3.1.7 Magnesium (Mg^{+2}): this procedure determines the Magnesium in water, soil extract,constitutes 33% of hardness ratioin water.According to SOP (25-50 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 was transferred to 250ml conical flask then add 25ml D.W. 2ml of Ammonium buffer was added to the sample, and added 1-2 drops of Erichrome Black T as an indicator and titrated using burette 25ml with EDTA (0.01 N) With continuous stirring until it reach the end point which is blue.

3.1.8 Sodium (Na): this procedure determines the Sodium concentration in water, soil extract. According to SOP (CCBA-SOP-009) transfer (25-50 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1, samples should filtrated carefully by Millipore filter (0.45µ). According to SOP (CCBA-SOP-011) using the calibration standard (NaCl) first to read at flame photometer (model: FP640) then reading samples emissions, drawing calibration curve at excel.

3.1.9 Potassium (K): this procedure determines the Potassium concentration in water, soil extract. According to SOP (CCBA-SOP-009) transfer (25-50 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1samples should filtrated carefully by Millipore filter (0.45µ). According to SOP (CCBA-SOP-012) using the calibration standard (KCl) first to read at flame photometer (model: FP640) then reading samples emissions, drawing calibration curve at excel.

3.1.10 Sulfate (SO_4^{-2}):this procedure determines the Sulfate in water, soil extract.According to HACH Procedure (DOC316.53.01135) (Method: 8051) (10 ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 was transferred to a beaker 50ml, a content of SulfaVer®4 Reagent Powder Pillows were add to the beaker that contain sample, swirl the sample to mix. Standing for 5 minute, the blank should prepared by transfer 10 ml of the sample to culture tube. Reading was done by using HACH spectrophotometer (M.N: DR/2000, S.N: 960800041462) with program 680 Sulfate

3.1.11 Phosphorus, Total (PO_4^{-3}): this procedure determines the Phosphorus in water, soil extract.According to HACH Procedure (DOC316.53.01121) (method: 8190) (5ml) was transfer of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 to a culture tube, content of Potassium Persulfate Powder were added, mixing and inserted it to a reactor for 30 minute at 150°C, cooling at room temperature and then 2ml of 1.45N of NaOH was added to culture tube, Zeroing was on this tube. the contents of PhosVer 3 Powder were added, mixing and reading after 2 minute at HACH spectrophotometer (M.N: DR/2000, S.N: 960800041462) with program 536 phosphorus.

3.1.12 Total Carbon, Total Organic Carbon, and Total Inorganic Carbon, Total Nitrogen (TC, TOC, TIC, and TN): this procedure determine Total Carbon, Total Organic Carbon, and Total Inorganic Carbon, Total Nitrogen water, soil extract. According to SOP transfer (10ml) of soil extract in SOP (CCBA-SOP-004) Step number 5.2.1 to volumetric flask 10ml and insert to ElementarVario TOC select (Model:Vario TOC select S.N:39161072) acidification for TC, TOC and TIC done inside the TOC device with H_3PO_4 (10%), and for TNP HCl (32%) outside the device.

3.1.13 Soil Texture: this procedure determines the type of soil sediment. According to T. A. Kettler, J. W. Doran, and T. L. Gilbert (2001) using 30g>2mm air dry soil in 100ml D.W containing 3% Sodium Hexameta Phosphate in 250ml Erlenmeyer flask shaking for 1h at Orbital shaker (M.N SI-1601, S.N: SI11601-85). Sample should sieving at 0.053 mm mesh at two different beakers. Sample should settling for 2H before getting rid of water, drying sample at Oven (M.N: LDO-030E, S.N: 2010080523) over night at 105° C.

5.4 References

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