

# **THE ANCIENT CLIMATE (PLEISTOCENE AGE) REFERENCES ON GEO-MORPHOLOGY FORMED IN IRAQ) (A STUDY IN HISTORICAL GEOGRAPHY)**

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## **INTRODUCTION**

The Pleistocene age presents the first part of the Quaternary Period for the “Cenozoic” which the Geological Time Scale includes\*. The Pleistocene extends from 1,6 million years to 10,000 years before the present time, by another word, at the beginning of the Holocene, the second part of the Quaternary Period. The Pleistocene got a special importance by scientists and researchers although the short period of time which the Quaternary period spent compared to the age of the earth and the extent of some eras (figure No.1), that’s because of the severe climate changes which distinguished this age<sup>1</sup>.

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<sup>1</sup>H.A.Right, Translated by, FuoadhamhKhorsheed, Effects of the Pleistocene Glacial Age in Kurdistan (Baghdad, 1986), pp7-8.

\*It is a chronological order organizing lithostratigraphy, events and Fossils according to their successiveness through the geological history from the oldest to the latest and by it the age of the earth geologically divided that is estimated of about 4,6 billion years, to four eras, the era divided into several periods, the period divided into several ages, the last age of the earth was the Holocene or the recent ages according the European principal which presents the last 10,000 years of the earth's age and the recent period. see ;

HamadRidha Ali Ibrahim, Geology “Earth Science” (Cairo), pp.104-108.

It includes four Glacial Ages, Glaciers in it overwhelmed the Upper Latitude Regions and the Continental Ice Patch which extended to the latitude circle (45 degrees) north words, intervened by proportional warm periods and interglacial ages where the climate in them was like now a days, while the regions far from the ice effect within the Middle Latitude circles, hadintervened by proportional warm periods and interglacial ages where the climate in them was like now a days, while the regions far from the ice effect within the Middle Latitude circles, had affected also by the global climate changes but in another way.Those regions distinguished by existing Pluvial and interpluvialperiods as in East Africa and the northern margin of the Islamic Deserts<sup>2</sup>, which includes Iraq.

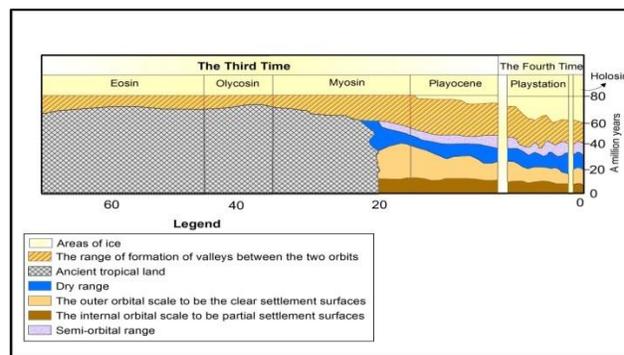


Figure (No.1)

A horizontal measure to determine the extent of the Quaternary Period (Pleistocene and Holocene) compared to the last third period's ages.

Source : Hart, M.G., Geomorphology Pure and Applied, Allen and Unwin, Pub Ltd, London,1986, P.56.

The Quaternary Period distinguished by occurring climatic changes overwhelmed all the earth, so the fast decline in the temperature degrees with a snow state fall had its effect to freezethe Northern Zones, and even on the high mountains in the hot zone itself. It occurred successive

<sup>2</sup>Ali A Alwaely, Hanan N Al-qaralocy, Kadhemi A Al-Asadi, Miqdam T Chaichan, Hussein A Kazem, The environmental aftermath resulted from chemical bombardment of Halabja Territory for the period 1988-2014, International Journal of Scientific & Engineering Research, Volume 6, Issue 9, September-2015,p.42.

humid periods and another drought during the last million years, later the drought periods called the non-pluvial periods. So, because occurring the successive phenomena of cooling and warmth in one period presented by the Quaternary Period, became looking at the drought ages as being a result of humid ages effects (non- Glacial)<sup>3</sup>.

The Pleistocene distinguished by existing Pluvial and non-Pluvial Periods affected on the stress and sedimentation factors which was overwhelming in that period that form two principal factors in differing the land manifestations, the Pluvial Periods distinguished by heavy rainfall caused water flow led to a great erosion of cliffs' surfaces and transferred the clastic rock fall to the flat land and deposited a great amounts of them in the valleys and lowlands, also in the lowlands locate at the slopes deposited the small and large clastic rock fall without classification<sup>4</sup>.

The non-pluvial (drought) periods that correspond the recent conditions distinguished by shortage in rainfall rates in winter rather than it was in the pluvial periods, the temperatures degrees increased in those periods as well as vaporization rates greatly if compared to the pluvial periods. Where the sedimentation and erosion factors of both kinds the watery and windy played a great role in affecting on region's morphology also led to continuing the operation of transferring the clastic rock fall sediments; in addition

the continued sedimentation operation in the region led to continuing the operation of entomb the valleys' bottoms extended between the mountain chains by calculus and sand transferred by current waters that formed the large conglomerate.

The temperature degrees at that period were ranging between running up and down with every pluvial and non-pluvial circle where Iraq climate becomes in the non- pluvial period which also called the warm period similar to the now a day's Iraq climate where the rainfall rates decrease in winter, while in summer the temperature degrees increase and evaporation rates greatly compared to what they were on it in the pluvial periods<sup>5</sup>.

That similarity in repetition of pluvial and Glacial periods relates to that, any cold period was accompanied by displacement and transfer the pressure system and then change in the global

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<sup>3</sup>Juda HasninJuda. The Glacial Age and the Pluvial Ages in the Islamic world Deserts (Beirut,1980),p.216-217.

<sup>4</sup>Nahida AL-Talabani, The Underground Waters in the Region Between the two Zabs and Utilize it (Sulaimania,2009),p.66.

<sup>5</sup>Nutzl .w, The climate change of Mesopotamia and Bordering Area 14000 to 2000 B.c ., sumer . vol ,xxx ¶¶ .No,1-2 . 1976c. p23.

\* In the front form because of it most the atmospheric depressions that affect in west Europe and the basin of Mediterranean sea towards south.

aerobic cycle, resulted from it an increase in rainfall during the pluvial Pleistocene period, this increase connected with an increase in the atmospheric depressions which the region was undergoing and affecting by the glacial crawl and what accompanied that increase in the great European atmospheric oppression strength which was crouching upon the huge ice blocks that was covering Scandinavian peninsula, inflation and its extending southwards, which caused pushing the Polar Front\*, this front was laying to the south of its present site in about(15) Latitude circles. So, whereas the recent site of the front at the latitude line(45 degrees) northwards that's mean that its site during the pluvial Pleistocene periods was near the latitude line(30 degrees), in other word it was laying south Iraq. So, rains wasn't limited on special seasons presented by spring and winter as it happened now a days, the present semi-tropical oppressive pressure zone which the dry trade winds' deserts connected with, break apart at that time by blowing a pluvial nautical polar air, therefore it was generating a pluvial period in the desert northern margin with every progress of the polar front the owner of every Glacial period<sup>6</sup>.

The first who put divisions for the four Glacial Periods are Bink and Brogner, 1909, according to their watches of the glacial periods in Bavaria region, where found four glacial clastic layers intervened by three non-glacial periods. The four glacial clastic layers corresponded with the successive four gravels beds of the Rhine valley and the other rivers<sup>7</sup>.

Bink and Brogner called the four glacial phases (periods)from the oldest to the earliest :Guenz, Mindel, Riss and Fuerm, according to the valleys names which the evidences found in them on that periods. While on the non-glacial periods that intervened them named (Guens-Mindel),(Mindel-Riss),(Riss-Fuerm)<sup>8</sup>.

### ***First: References the ancient climate:***

The absence of direct measures as a guide referring to the ancient climate was a reason led many scholars and interested people in this field to search for ways and methods enabling them to know the ancient climatic characteristics, like depending on the geomorphologic ,geological, zoological, botanical, evidences that focus on studying and analyzing the tree rings, growing of

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<sup>6</sup>JudaHasnninJuda. Ibid , p.227.

<sup>7</sup>Buthaina Salman Mohamed AL-Jubory, Biological References of the Climatic and Environmental Changes in the Quaternary Age for the Sedimentary Plain "South Iraq", Master Thesis, College of Sciences, Baghdad University(1997),p.1.

<sup>8</sup>Mohamed Rasheed AL-Feel, Development of Iraq Climate Since the Beginning of the Pleistocene Till the Present time, College of Art Magazine, Baghdad University, No.11 (1968), p.235.

lichens, analyzing ice silt chips, studying the clastic glacial, use the radioisotopes to define some phenomena ages etc. What helped them in that the diversity and progress in scientific research methods. In the following some evidences which are commensurate with the subject of the study that by them it can be concluded the climate kind that left its print in it:

### ***1- Land Forms:***

There are many of land forms that are consider of ancient climate legacies, so some of those forms provides accurate information about the ancient environments that established and formed through them.

In the high latitude regions that affected by glacial extensions, it can be concluded the annual average of the ancient temperature degrees from distributing the Pingos hills\*, that developing during the cold conditions and permanent frosting, which has a relation of temperature degrees average, according to that, temperature degrees that by them Pingoshills are formed, can be determined.

Of the other glacial forms which are consider as an evidence of overwhelming glacial ages in one of the glaciers' history periods\*, not because they are themselves only a form of glacial ages' forms but also of what they leave behind them after melting of shapes may by them follow the progress process of ice in earth areas, of those forms are the stray rocks\*\*

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\*Is a great movable glacial block, move in currents like rivers.

\*Are rocks Holden by glaciers from some place and deposited in another place far from their original place after ice dissolve and contract the glacier area cause of the overwhelmed climatic conditions in the present age.

\*They are remains of clastic rocks deposited after ice dissolve.

and also the sedimentary formations of terminal glacial moraines. The same case apply on the Fjords\*, that formed by melting glaciers and their decline during warm periods leaving their valleys to be occupied by the sea waters\*.

The fossilized dunes(constant) form one of the fossil evidences referring to overwhelm the desert climate through the inter-pluvial periods(coinciding with the inter glacial periods)which form only in the regions the rainfall be in them lower than (100-200 mm) annually, while if the rainfall increased over that quantity the sand movement decreases to a great degree as a result of increasing the botanic cover that covers their parts, so existing fossilized dunes in heavy pluvial regions in the present time means that the averages of rainfall may increase after these dunes formation.This kind of dunes can be distinguish from the active dunes by deep weathering features and concentrated iron oxides, developing clay and humus and silica and carbonate accumulations<sup>9</sup>,so in the limits of the study there is a number of land formations referring to overwhelmed pluvial periods where the region covered by a net of dry valleys some of them consist of lean defiles refer to a high quantity of drain could be found through the geometric formula of the defile, also the alluvial fans, river terraces, glacial surfaces, all of them refer to an overwhelm of heavy pluvial periods<sup>10</sup>, and in the Pleistocene age the last age of the third period the torsional movements were in its highest level that made Zagros Mountains take their present shape and established in them a group of simple and complex torsions towards the north west and the south east, of these geomorphologic forms that refer to the climate's kind during the Pleistocene:

***a- River terraces:***

The existence of these terraces confine near the Great Zab River. It consists of ConclamorateAdastat of sandstone and Grin stone \*

***b- sediments of slopes:***

Exist in the western foots of Mount Brad stead and Mount Bakian as well as their existence in the western side of Mount Merke a wall of Mount Brastead chain after the latest Quaternary period sediments consist of stone fragments with fleecy clasticrock fall sediments, the Quaternary period occupes also some close sloops parts of valleys and rivers cause it consist of very new stones that formed by erosion processes which happened on the sloops of this region forming these very new configurations and still continuous in formation till now.

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\*Very deep glacial valleys ,the resent beach line approached to them and rose over their level, and in sated of being a rectangular lake basins appeared as if they were gulfs from the sea extended over land confined between cliffs, see; The Assembly of Arabic Language, Geology Dictionary, op .cit. pp.162-184.

<sup>9</sup>Mohamed Sami Aasal, The Natural Geography, vol. 1(Egypt, 1984),p. 363.

<sup>10</sup>HasanSadiq, Geology (The Modern Library, 1929), p. 124.

In the early times of the Quaternary period (the Pleistocene), the torsional movements continued to complete forming Iraq mountains<sup>11</sup>.

### *2- Erosion processes:*

Stones expose to decomposition and erosion as a result of the chemical interactions which implement among their components (elements) and some atmosphere gases such as Oxygen and Carbon dioxide under a special climatic conditions lead to a change in their chemical composition.

Water forms a principal essence in the chemical weathering. Also the chemical interactions become more active in high temperature degrees, so the result of weathering processes considers a clear evident on the overwhelming climatic conditions during the processes<sup>12</sup>. For example, existing red sediments refers to a warm climate and seasonal rain, the reddish of soil refers to an annual average temperature degree increases over (16centigrade) and the annual rainfall reaches over (300mm).

In addition to that there are huge quantities of minerals unaffected by weathering that contains Felspar\* used in determining whether the tropical climatic is durable drought or semi-drought or humid conditions overwhelmed during determined periods, in drought periods rivers tend to carry Felspar unaffected by weathering, while through the more humid conditions the quantity of Felspar decreases relatively against Quartz<sup>13</sup>.

Also Cyanins mineral may composes in the regions exposes the mother rocks to a great leaching of igneous and sedimentary rocks weathering outputs containing of Feldspar minerals or may composes principally by crush (reworking) sediments. So, Walast considered that the Cyanins portion in clay parts is a measure refers to the chemical weathering upon the mother rocks under a heavy pluvial conditions and good drainage for waters and high soil penetration. As it could also be transferred from ancient soils and sediments by rivers or winds to deposit in sedimentation basins as detrital materials.

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\*Geological Column for the region of study (No. 1).

<sup>11</sup>Jasim Mohamed AL-Khalaf, Lectures in Iraq Human, Economic, Natural Geography (Egypt, 1959), pp. 18-19.

<sup>12</sup>TaghlibJerjeesDaowd, Applied Geomorphology (Baghdad University, 2002), p.80.

\* A mineral consists of Aluminum Silicate and other old elements.

<sup>13</sup>NuomanShahata, Jordan Climate (Jordan,1990),p.24.

**Rocky:** The study of rocky gives plentiful information can by them conclude the kind of climate. For example, formations of stones and gravels in humid conditions, so their formation need enough rain or water drainage, therefore if it was found in one of the recent layers on such compositions, that is mean that they formed during a pluvial period. If it found two successive layers each layer of them consisting of configurations differing from those of the other layer that is an indicator revealing that both layers formed in different special climate conditions.

The terminal moraine refers to that the region had exposed to a glacial erosion, in other words it is an evidence on the glacial environments and the red layers sediments that form after the conditions of temperature degrees and humidity prepare the ideal weather for Iron to transfer to its Red Oxide, so their existing connect with humid hot regions. The same condition applies on the gray loam that forms in a large swamps referring to transfer the climate conditions towards more humidity, and the clay periods which indicate to the heavy pluvial periods<sup>14</sup>.

Also it can be depended on the chemical composition for stones to achieve a progressive results to such a kind of study and of the dependable rocks as an evident because of its chemical composition are the limestone rocks that present the best indicator of the hot climate, because lime dissolve and its sedimentation depends largely on CO<sub>2</sub> in water and it is evident scientifically that CO<sub>2</sub> is decrease whenever temperature degrees increase and sea waters dissolve double quantity in (zero centigrade), of this gas other than (20 centigrade); that's mean that the water ability on carrying larger quantities of dissolved Calcium Carbonate increases in low temperature degrees. So, the thick limestone rocks sediment composing in shallow warm seas, according to that limestone rocks considered an indicator to the hot climate, the same condition applies on the coral reefs, that form within a thermal range ranging between (25-30 centigrade), and of other stones that may consider as an indicator of hot climate are the Gypsum rocks<sup>15</sup>.

#### ***4- Lakes Level Changing :***

Closed lakes exposing to vibration and change in their waters levels because of the climate change, whereas the change in area and deepness of these lakes almost reveal clearly from the clear successiveness of the ancient coast lines or from the sudden change of the sedimentary Facies sections. The closed lakes or their remains are more prevalent now a days in the drought regions and semi-humid especially in the tropical and semi-tropical regions<sup>16</sup>.

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<sup>14</sup>Nuoman Shahata, op.cit., pp.24-29.

<sup>15</sup>Ali Hassan mussa, The Climate Changes (Syria, 1985), pp.99-110.

<sup>16</sup>Balsam Salim Majeed AL-Tauash, The Pleistocene History in Razaza and Tharthar Downs in the Middle of Iraq, ph.D., Theses, Geology Department, College of Sciences, Baghdad University (1996), p.2.

Those lakes formed as a result of a heavy rainfall and decrease of the temperature degrees during the Pleistocene, which helped reducing the average of evaporation and at the same time the rainfall increase helped keeping the water surface on high levels during that period. While at warm periods the water surface level of these lakes declined. Therefore, every line of lake's beach presents a full climate cycle starts by a water floating and depositing/regimenting its loads during the pluvial period and ending by water abatement during the humid period<sup>17</sup>.

### ***5- Radioisotopes :***

One of the conducted methods in diagnosis the ancient climate during the ancient geological eras, like to say, we may determine temperature degrees portion by Isotopes of Oxygen (O18/O16) or using Oxygen (O18), in determining the ages where they determined by about 175,000 years, and use Carbon(C14), to determine the periodical ages of the organic materials where their age determined by about 50,000 years or by extracting the Carbon(C13/C12) portion in order to differentiate between land plants and marine plants and differentiate between continental environment and marine environment, also Potassium Argon used to determine the fossils, or by determines Boron portion to differentiate between waters salinity (sweet, salty, or mixed waters)<sup>18</sup>.

It had utilized by the evidences (1-2-3), in determining the climate kind which was overwhelming during the Pleistocene in the recent study.

### ***Secondly: The Climate State Through Geological Ages:***

It can't be given an adequate image for the actual climate that was overwhelming Iraq during the ancient geological ages, to make that there must be a direct records for the weather elements to extract the averages of these elements, so, whenever the period of recording was long it gives a better image, and while the oldest record of weather elements do not exceed (300 years), and a great number of world climate stations didn't established but in this century<sup>19</sup>, therefore it would be difficult to determine the climate kind which was overwhelming during those eras especially those preceded the third period because of the methods and evidences limitation that can be

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<sup>17</sup>Thamir Khaazal AL-Amiri, "The Quaternary Geology" Human Being and Environment Between Accommodation and Dangers of Land Events (Baghdad, 2000), p.78.

<sup>18</sup>) Ibtisam Ahmed Jasim Mohamed AL-Qaisy, "Geomorphological Legacies of the Pleistocene Holocene Climate in AL-Sudour-Himreen Region East Iraq" A Morphological Study", Master Theses, Geography Department, College of Education/Ibn Rushd (2001), p.93.

<sup>19</sup>Qusay Abdul -Majeed AL-Samaraay, "The Old and Present Climate of Iraq", Literature Magazine, No.50(2000), p.111.

depend on. But the overwhelming character of the earth climate since its genesis is the unstableness of climate, what support this conclusion is the following of the relation between the land and water dimensions during the geological ages, the continents weren't in their present place as well as the seas, even the sites of the both poles weren't in the sites known nowadays. However, it is possible to display an approximate image for the climate overwhelmed the earth surface during the late eras of its age.

In the second age (Mesozoic), the climate was warmer than the recent earth climate, so there weren't any evidences refer to occur glaciers, though some regions witnessed a very cold weather in some periods but it didn't reach to the glacial stage, In the Triassic Age (225-190) million years ago (the first age of the second period), the climate was drought and very hot intervened by some humid periods, through it the climatic zones became configuring on the earth surface, with evidence existing the same kinds of plants in different geographical latitudes<sup>20</sup>.

While in the Jurassic Age (180-130) million years ago, (the second age of the second period), the temperature degrees had decreased generally upon the earth surface during winter, while in its middle the temperature degrees started to increase and the climate gradually went towards heating till the end of this age, with evidence that the coral reefs which were few in the early parts of Jurassic age increased in its middle, so that presents an evidence on the increase in temperature degrees then after that these reefs transferred towards equator when the Jurassic age came to a close and that was the beginning of establishing the geographic zones because differing the climate in between them. After that and in the Cretaceous Age (130-70) million years ago (the last age of the second period), the climate went towards the gradual decrease in the temperature degrees but it didn't reach the glacial stage, it remain as a whole warm and humid upon the earth surface<sup>21</sup>.

With the beginning of the third period since about 70 million years ago, the important manifestations of the earth geography became clear. The use of Oxygen isotopes measures got the principal role in determining the general manifestations of the earth temperature degree in this age. Also the changes in the level of seas surfaces played an important role in determining the kind of climate that overwhelmed that period, especially the in the regions which were structurally stable (those that didn't expose to raise and fall movements). The climate of this

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<sup>20</sup>It had been depended on the global climate to explain the state climate which overwhelmed the region of study that consider a part of the global, cause there are no studies dealt with the ancient climate in the region's study, especially during the ancient geological ages, see ;

Ali Hassan Mussa, op.cit. p.119.

<sup>21</sup>ibid., p.120.

geological era of the earth history distinguished by what plants which were growing through it, where the plants of the hot climate were growing abundantly in the middle and high altitudes the evident on that is all the coal or carbon configurations relate to this period exist in these altitudes. Generally, the different earth parts exposed to heating in the early and middle parts of the third period, and perhaps the extended diffusion of the pluvial warm conditions in some parts of the world during the third period had its environmental effect, where the erosion processes in many

middle latitude regions and laterite existed. The limestone rocks exposed to a very heavy melting processes and the decompositions of their rocks, the result was a fast response to the glacial erosion of the Pleistocene<sup>22</sup>.

At the beginning of the Mayosian Age (the quaternary age in the third period) and depending on the rocky description for the oldest stratified rocks discovered in Jabal Himren which relate to this age, and also studied by (Hamza, Domas, 1980), (Domas, 1948)<sup>23</sup>.

## CONCLUSION:

It can be possible give a more accurate and scientific description about the ancient climate of Iraq where the stratigraphy column consists of rock sediments in different sedimentary environments, lagoon and fluvial emerges the climate kind that they sediment during it and as the following:

- 1- The Mayosian period in Iraq distinguished by a number of fluctuations, in its beginning (the lower Mayosian), deposited clastic sedimentary composed of sand and sandstone. The sedimentary environment of these materials indicate to fluvial environments, namely it is in the beginning of the Mayosian age overwhelmed upon it a humid climate participated in deposited the sandstones.
- 2- Starting from the middle Mayosian age the Tethes sea receded leaving after it lagoon evaporated basins some of them are closed and others are connected with the sea by arms, in these basins sediment layers of lime, limestone and clay stone. The lime layers indicated overwhelming a humid drought climate led to continuous evaporation. During this period deposited the stones of evaporates relate to the Fatha Formation).
- 3- The process of connect and disconnect Tethes sea during the second period ages was cyclic, so the succession of Gypsum, limestone and Marl appear in Fatha Formation that the stratigraphy column consists and discovered in Iraq, where the marine sediments like

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<sup>22</sup>N.M. Hamza & J. Domas, Report on the Geology of the Adhaim area, GEOSURV, Baghdad, 1980, P.22.

<sup>23</sup>J. Domas, Report on the Geology of Karbla -Ku- and Ali AlGharbi areas, GEOSURV, Baghdad, 1980, P.113-114.

limestone and Marl with some animal remains of that period during sea proceeding, and during its disconnect increase the waters salinity which led to sediment lime and Marl, also increase the Miogypsite fossil in these stones. It may consider the said above sedimentary as lagoon deposits<sup>24</sup>.

4-In the Middle and Lower Mayosian started the Alpine sprains, to reach its utmost in the upper Mayosaine which rose from that the mountain highlands in different parts of earth grounds which consisted of Taurus Mountains and Zacro Mountains in the northern and east northern parts of Iraq<sup>25</sup>, <sup>(34)</sup> which coincides with it at the end of the Middle Mayosaine and the beginning of the Upper Mayosaine recede Tethes sea ultimately not from the region only but from all the Iraq territories leaving behind it sedimentary basins filled later by fluvial sediments (Injana Formations), which includes sedimentary stones of Siltstone and Silt transferred by braided rivers occurred in a pluvial conditions. That's referring to a region witnessed transformations from the drought climate to the humid climate.

5-The humid climate continued during the Pliocene (the last age of the third period), during it transferred huge quantities of sediments from the highlands (Zacros and Turus nowadays) to (the low adjacent basins of them), by fluvial nets presented by valleys recently cover the region which many of them dehydrate nowadays because of drought conditions. It can be noted the increase of gravels portion existence upwards which reflects the increase in rainfall. In other words, the region during the Pliocene age was under a very humid climate. During this period deposited the stones related to the Muqdadiya Formations (Lower Bakhtaran Formations previously), Bai Hassan Formations (Upper Bakhtiary previously), and all of them deposited within continental conditions and have the Molasses feature (all of them of Clastic), consists of sand and clay conglomerates formed by the continues rising of the region and expose some of its upper parts to erosion factors so fragmented parts of them and accumulated finally in the adjacent downs. The Muqdadiya Formations contain of silt stones, Marl, sand stone with pebbles. These formations are similar to Injana Formations except that they are containing layers of sand stone which contain a quantity of pebbles in the upper part of these layers. While these belong to Bai Hassan sedimentation, the rocky formations consist of thick sediments of rock conglomerates.

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<sup>24</sup>Adnan Baqir AL-Nakash, Structural Geomorphology and Geology and Iraq Geology (Baghdad, 1985), p.239.

<sup>25</sup>Fadhil Baqir Hassan, Development of Iraq Climate through the Geological periods and Historical Ages, Iraqi Geographical Society Magazine, vol.10(1976), p.367.

6-Being close to the Quaternary period the climatic image starts to be clearer because of the geomorphologic evidences diffusion in Iraq that reflect overwhelming a climate distinguished by very humid periods, in them there was a heavy rainfall that enabled waters to made their course and transfer a huge quantity of rocky clastic. During the Pleistocene (the first age of the Quaternary period) started another sedimentary cycle of the clastic sediments as a result of breaking and fragmenting the ancient fluvial terraces by the water currents erosion processes activity in addition to the transferred fluvial sediments of silt and gravels and all these sediments relate to the continental environment conditions which accumulated in the downs caused by the Alpine Orogeny movement and this also in turn covered all the previous ancient formations that configured during different geological periods.

7- During this period the erosion processes by the water currents led to deepen these currents which in turn increased the erosion rates and transport the fragmentation outputs resulted from erosion processes of the mountain chains towards the bottoms of the valleys and downs, the anticlines exposed to water erosion led to break them down and forming nets of dense valleys, as well as erode large fragments of exposed layers on their surface which led to form several levels different terrain presented by Cuesta and bad lands, in the region emerge two levels of bad lands separate them Glacial eroded sloop. These both levels of Bad Lands emerge two different durations of humid climate that suppressed to it the high lands.

8- In the same period the erosion remains transferred by rivers which formed then to the low region and formed different geomorphologic units at the folds foot presented in the Alluvial Fans where four levels of them found within the zone of study, that reflects a humid climate provided in it heavy waters formed rivers of high transforming abilities deposited these manifestations. The four levels of the alluvial fans reflects overwhelming humid climatic durations intervened by drought durations the evident on that was existing layers of Secondary Gypsum located on fans surfaces.

9- The humid climate continued with the beginning of the Holocene with evidence breaking down the alluvial fans and continuing the sedimentary glacial surfaces as well as existing the rich sediments of organic materials as a result of forming marshes and swamps and their developing during this period, after that the climate began to change from humid to drought. In a detailed study for Pant<sup>26</sup>, depended in it on the floods of Tigris river as an evident to determine the climate kind, he reached that in (1200-1400) years before present time was a very humid period because of the highest number of

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<sup>26</sup>P.S. Pant., Climatic change over Mesopotamia during the past six thousand years, without date, P.16.

Tigris river floods, while the period (1400-1600)years before the present time presents a drought period didn't through it happen any floods. NUTZEL, presents the temperature degrees and the quantity of rain fall in Iraq for 14 thousand years to 2000 years B.C., where the glacial Feurm period was the most severe period. The temperature degrees decreased in it to (-6)centigrade, namely under their recent rates(A-2) that is in the year14 thousand B.C., and the level of ice decreased to about (700m)than its recent level in north Iraq. This period witnessed vibration in temperature degrees and in the humid and drought periods affected on the water level of the Arab Gulf,so in the humid periods the water levels raised to (35m)than the present level, where the gulf waters reached to Baghdad city nowadays, while the water level decreased about (110m),than its recent level in the drought cold periods where Tigris and Euphrates rivers poured in Oman Gulf at that time, where the recent Arab Gulf presented in that time a low ground<sup>27</sup>.After Forumperiod the temperature degrees increased gradually till they

reached to about (-2,5 centigrade),in Dears period limited between (8000-9000 years) B.C., returned the temperature degrees rates to increase after the year (7000 B.C.), where they increased about one degree centigrade during the period limited between (7000-6000 years) B.C., and (2centigrade), between(6000-5000 years) B.C., after that they reached to their utmost increase in the period between(5000-3000 years)B.C.,where the increase reached to(3 degrees centigrade),and this period presents the Atlantic Period. While after (3000 years)B.C., the temperature degrees became similar to that of nowadays.

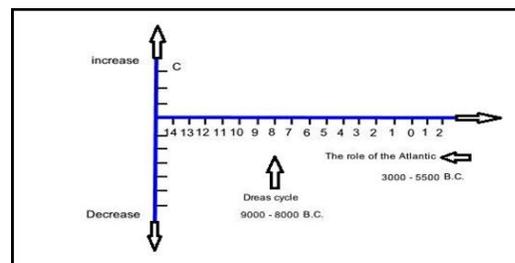
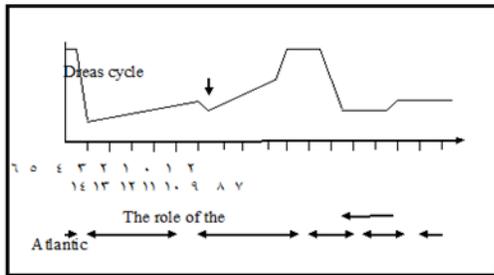


Figure (No.2)

temperature degrees and rainfall quantities at the later part of the Pleistocene and the early part of the Holocene in Iraq.

<sup>27</sup>Qusay Abdul -Majeed AL-Samaraay,op.cit.,p.115.

B - Quantities of rainfall in Iraq between 14000 - 2000 years BC.



Reference: Nutzal, The Climate change of Mesopotamia and Bordering area, Summer magazine, vol.32, Baghdad, 1976, P.14.

A- The annual temperatures degrees rates in Iraq between(2000-14000 years)B.C.

About rainfall it is vibrated in its quantities, where the early period before the year (14000 B.C.), which presented by section (E), figure(B-2), distinguished by heavy rainfall quantities, while the period extended between (14000-5500 years)B.C., which represented by section(D), distinguished by vibration between increase and decrease, while the period (C), where in it the rainfall quantities returned to increase significantly, succeeded it the period (B), that the rainfall quantities decreased largely, then it had recorded an increase in quantities presented by the period (A).

In more accurate image, it emerges a gradual increase in the quantities for the duration between(14000-9000 years)B.C., then this quantity decreased in the period between(9000-8000 years)B.C., presented by Triassic period, the quantity turned another time to the gradual increase till the year(5500 B.C.), from this year started the great increase which presented by the period between(3000-5500 years)B.C., the decrease in the rainfall quantities turned again to decrease for the period extended between(500-3000 years) before present time, so it was presented the last humid period, and after the year(3000) before the present time, the severe drought began and the climate took its present state<sup>28</sup>.

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<sup>28</sup>Nutzal, The Climate change of Mesopotamia and Bordering area, Summer magazine, Vol. 32, Baghdad, 1976, P.13-23.

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