

**The Impact of the Ancient Climate on the Course of the Euphrates and Its  
Geomorphological Phenomena between the Cities of Al Khidr and Basra - A  
Study in Historical Geography**

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## **Introduction**

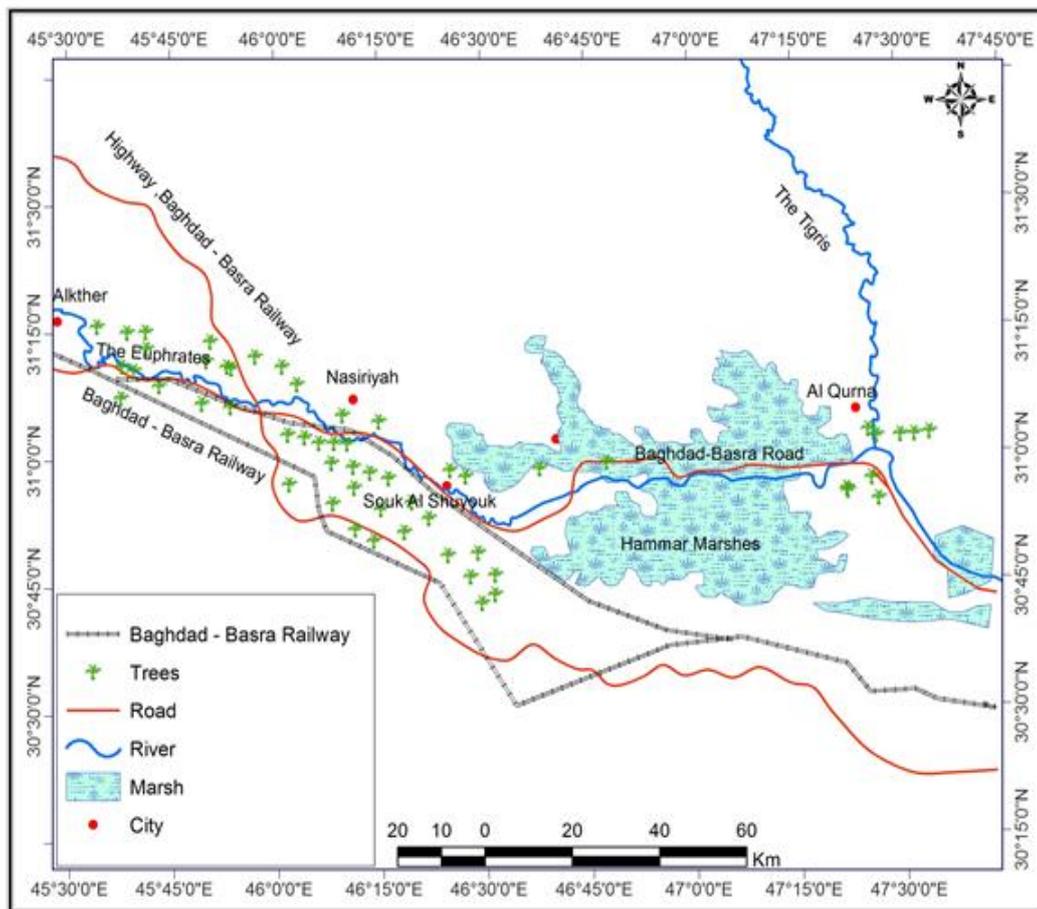
Historical geomorphometric studies are one of the modern trends in historical geography and in the historical study of rivers and their basins, whether small or large. The riverbed and basin are commonly the basic unit for geomorphometric research. These studies also contribute to clarify and define the environmental characteristics of rivers and how they were formed and the factors that helped this process.

River valleys are one of the largest fields associated with human stability and activity, Such studies are needed as the river environment controls the work of current activities. The study focused on the historical aspects of the ancient climate, which determined the course of the Euphrates River and its geomorphological phenomena between the jurisdictions of Al Khidr and Basra. See map (1). The phenomena are prominent and extensive within and outside the course of the river, are in continuous change and have a substantial effect on human activity in the region. The search focuses on this topic, as it also seeks to benefit from detailed maps and remote sensing systems in describing and analysing several old phenomena and drawing maps showing the morphometric characteristics of the river.

**Key words :** Geomorphological Phenomena, climate, Alluvial plain, corresponding glacial periods, The Euphrates.

Map (1) Study Area

The Euphrates course from Al Khidr to Al Qurna jurisdictions  
Souq Al Shuyoukh



Source: Ministry of Water Resources. Engineering Designs Department. Unpublished information.

**Research Problem:** Does the old climate have an impact on the Euphrates river course and its geomorphological phenomena in the study area?

**Research Hypothesis:** The old climate has an impact on the Euphrates river course and its current geomorphological phenomena in the study area.

**Objective:** To determine the effect of the most important fossorial climatic elements on the river course in the studied area.

## Climate

Climate is one of the most important natural factors influencing the formation and development of geomorphological features in varying degrees determined by the response of these phenomena to each element of the climate separately and the combined effect of these elements together.

Davis is one of the first geomorphologists to address the impact of climate on Earth's surface forms through what he called the Geomorphological Cycle. He distinguished between glacial cycles and dry cycles, which he called climate events. He explained that geomorphological processes are climate-dependent and climate change<sup>1</sup>. The climate is one of the factors that change the long-term features of the Earth's surface and its levels vary by the amount of weathering and erosion activity in the region and precipitation in another area<sup>2</sup>. Climate is also a major factor in the development of watercourses, as it is the driving force for the development of surface erosion, sedimentation and sediment transport. It therefore develops many types of watercourses and associated terrestrial forms. For the integration of the historical geomorphic study, it is necessary to study the old climate developments over successive periods .

### Old climatic clues (Paied Climate):

Quaternary is one of the secondary divisions in the geologic time scale and represents the last 1.8 million years of Earth's age. The most important characteristic of this period is the climate change, the expansion of continental ice and some glaciers in the upper latitude

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<sup>1</sup> Louis C. peltier , the Geographic cycle in periglacial Regions as it related to climatic Geomorphology , Jour , Geo. Soc. Am. Vol. 16, 1950 , P 214 .

<sup>2</sup> Boshra Ramzan Yassin, The Spatial Relationship Between Levels of Surface and Agriculture in Basrah Governorate, PhD Thesis (unpublished), Faculty of Arts, University of Basrah, 1998, p.33.

regions<sup>3</sup>. Ice also covered various locations in some continents within the central latitude.

As the river course of the Euphrates is associated with climatic conditions other than the current conditions in particular and its association with Alluvial plain (Floodplain) in general, in this study, we discussed the history of climate for the Quaternary. This is attributable to the varying nature of these conditions of temperature and wind and rain and the extent of their potential impact on the Alluvial plain (Floodplain) and riverbed, especially, since the relationship between climate and geomorphological processes at the time was very large. The composition of many terrestrial forms was influenced by climatic elements. Owing to the ice and rain sequence in one time, the Quaternary, rain periods are seen as a product of the influence of ice spans. Drought periods have also been seen as a product of the effects of non-glacial warming. See table (1). It is known that Iraq and the Arabian Peninsula witnessed four Pluvial Periods during the Glacial Periods in the northern regions of Europe, Asia and America, corresponding to those in Africa and the Eastern Mediterranean. These ages were characterized by the abundance of groundwater that flowed into the rivers, which led to the expansion of their streams and the rise of their basal levels during those ages. Many sources indicate that the Quaternary was a glacial period. At the same time, there were large areas of the globe other than glacial ones such as the Arab region and Iraq. However, this does not refute significant climate changes<sup>4</sup>.

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<sup>3</sup> Buthaina Salman Mohammed Al-Jubouri, The Biological Evidence of Climate and Environmental Changes, in the Quadratic Period of the Sedimentary Plain, Southern Iraq, Master Thesis, Department of Earth Science, Faculty of Science, University of Baghdad, 1997, p.1.

<sup>4</sup> Qusay Abdul Majid al-Samarrai, The Climate of Iraq in the Past and Present, Journal of the Faculty of Arts, University of Baghdad, No. (50), 2000, p. 60

Table (1)

Glacial periods in Iraq and the Middle East and their corresponding glacial periods in Europe

East Africa	Iraq	Northern Europe	periods
Makalian/Gamblian	Pluvial	Würm started 120,000 years ago	glacial period
Interpluvial	Interpluvial	Riss-Würm	interglacial
Kanjeran	Pluvial	Riss started 250,000 years ago	glacial period
—	Interpluvial	Mindel-Riss	interglacial
Kamassian	Pluvial	Mindel started 500,000 years ago	glacial period
Interpluvial	Interpluvial	Günz-Mindel	interglacial
Kanjeran	Pluvial	Günz started 600,000 years ago	glacial period

Source: P., Buring Soil and Soil condition in Iraq, Baghdad, 1960. P. 142.

The region has been affected by major climatic developments during the geological ages that Iraq has experienced in general and the study area in particular. That includes hundreds of millions of years. This effect is reflected in the Quaternary, which represents the most recent phase in Earth's history<sup>5</sup>, characterised by sequential Glacial Periods and interglacial periods. The latest was Würm glacial period\*. There are many indicators showing that each glacial period lasted about 100 thousand years, each of which included ten thousand years in which ice retreated.

<sup>5</sup>Mohammed Rashid Al-Fil, Evolution of the climate of Iraq since the Palaeocene until the present, Journal of the Faculty of Arts, University of Baghdad, No. (11), Baghdad, 1968, p.246.

\* Würm glacial period: refers to the peak of cold reached by the Ice Age, which prevailed from about 4000 to 13,000 years BC. M. The result of extensive stretches of snow on the ground during this period was that large quantities of sea and ocean water had withdrawn to current levels of about 110 m. Review: Werner Nutzl, translated by Saadi Faidi Abdul Razak, the Arabian Gulf has been since 14000 BC. M, Gulf Arab Journal, Center for Arab Gulf Studies, No. 7, University of Basrah, 7 197, p. 29.

In the late Pleistocene and the Holocene epochs, Iraq experienced several rainy periods that were wetter than they are today, interspersed with dry periods where the climate was similar to what it is today<sup>6</sup>. Alluvial plain temperature during this period, the recent Wurm period, was estimated to be 6-7 m<sup>2</sup> less than present values<sup>7</sup>. During those times, northern Iraq also witnessed large amounts of ice. The reason for this was lower temperatures and increased precipitation. This means that the climate of Iraq during the glacial period has witnessed higher humidity and lower heat and that the transition of the wet-dry climate is due to a change in the pathways of the prevailing anticyclones responsible for precipitation<sup>8</sup>.

Describing a particular period as pluvial means that the hydrological and biogeographic conditions were all more humid than the present. Describing a period a interpluvial or a pluvial period as dry means that the information about the old environment shows drier conditions compared to rainy periods. Describing periods as wet or dry depends not only on the amount of rainfall but also on the availability of water at a particular location<sup>9</sup>. The abundance of water in a particular area or location depends on several climatic factors, the most important of which is rainfall and temperature, especially since rainfall is the first climate factor. This depends on the quantity and distribution during the year. Moreover, temperature is very important in determining the pluvial

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<sup>6</sup>Mohammed Rashid Al-Fil, Evolution of the Climate of Iraq since the Pleistocene to the Present, op. Cit. , p. 247.

<sup>7</sup>Balsam Obeid Al-Tawash, History of the Plastocene of the Lower Razazah and Al-Tharathar in Central Iraq, Dissertation (unpublished), Department of Earth Science, Faculty of Science, University of Baghdad, 1996, p. 69.

<sup>8</sup>Jafar Alsakna, a new window on the history of Lafratin in the light of geological evidence and archaeological discoveries, Dar General of Cultural Affairs, Baghdad, 1993, p. 45.

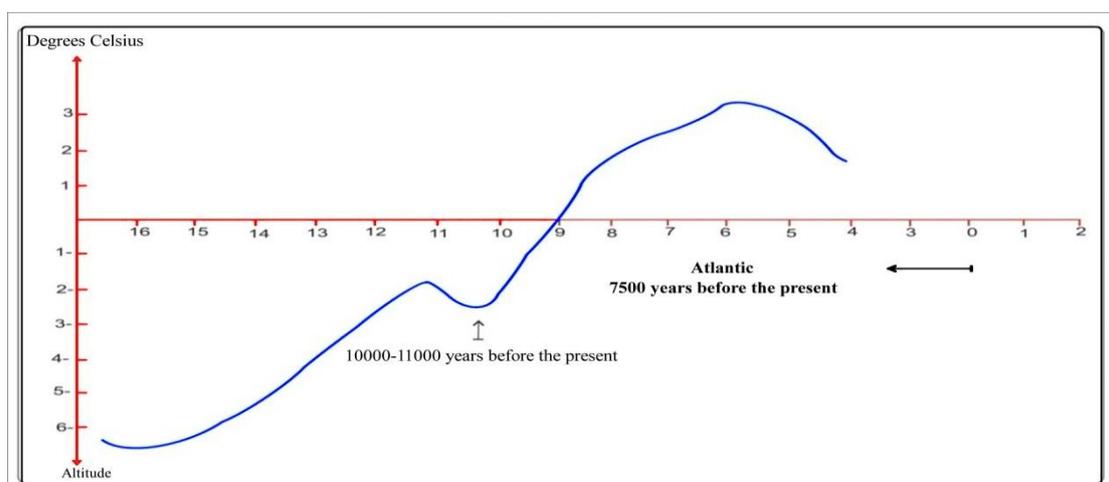
<sup>9</sup>Rognon , Pluvial and arid phases in the sahaya , The role of non-climatic factor , Paleocology of Africa , Vol. 12 , 1980 , P.45 , 61 .

period, since temperatures reduce the evaporation rate and thus help increase the amount of water available<sup>10</sup>.

The rainy periods were characterized by the profusion of water that flowed into the rivers. This led to the expansion of their streams and the elevation of their banks and base level. The rotation of the rainy and dry periods in Iraq, in addition to geological tectonic resulted in the ancient river terraces north of the alluvial plain (the floodplain), the marshes and swamps in the south, along with river course changes dating back to different periods of the Pleistocene epoch<sup>11</sup>. During the late Pleistocene epoch, which represents the decline of ice within the glacial period, Iraq in general and the study area in particular, witnessed rainy periods characterized by more humid climatic conditions and less temperature than the present. The temperature was 5° C lower than the current rate. See Figure (1). This period was set at 8000-14000 BC. This wet period can be counted as a transition period between the Pleistocene and the Holocene

Figure (1)

Temperature rates in Iraq and the study area 4000-16000 years ago



<sup>10</sup>Ibid, P. 61 .

<sup>11</sup> Jafar Alsakna , A New Window on the History of the Furatins, op. Cit., P. 40.

Source: W. nutz, the climate changes of Mesopotamia & bordering Areas, 14000 to 2000 B.C. Samer VOL 1no .1-2, 1976.

By the end of the Pleistocene epoch, the Holocene epoch began, 11,000 years ago. During this period, the conditions of humidity and warmth continued until 9000 - 6000 years ago. It represents a rainy period, considered the source of the legend of the flood, which happened thousands of years ago at the time of the Sumerians<sup>12</sup>. In addition, quite a few researchers have proved that this period represents a moderately rainy period that led to the emergence of devastating floods in Iraq. These rains also increased river erosion from highlands and their sedimentation in lowlands, particularly the sedimentary plain. This period also caused global sea level rise, which is called flandrian transgression. During this period, the land between the north of the country and the Arabian Gulf turned into a paradise. Iraq enjoyed seasonal winds that were more wet and rainy.

This also led to the rise of the water level in the Arabian Gulf to reach three meters<sup>13</sup>, until the border of the Arabian Gulf during this period reached the city of Ur between 5000 and 35000 BC, and the drainage of the streams of the Tigris and Euphrates saw major changes. It can be said that there have been deviations in the climate of Iraq characterised by an increase in humidity and drop in temperature during the Ice Age, and increased drought and high temperature in the post-Ice Age<sup>14</sup>. As a result, they have left many geomorphological forms that indicate these deviations, periods and changes that have occurred. The most important are the gravelly fans, the valleys, the marshes, the depressions, the old water channels, the river terraces, and the ancient archaeological sites that indicate the change, movement and advance of

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<sup>12</sup> Fadel Baqer al-Hassani, Evolution of the climate of Iraq through geological times and historical periods, Journal of the Iraqi Geographical Society, No. (10), 1978, p. 386.

<sup>13</sup> Reda Jawad al-Hashemi, The Natural Limits of the Head of the Arabian Gulf, Journal of the Iraqi Geographical Society, No. 13, 1982, p. 230.

<sup>14</sup> Fadel Baqir al-Hassani, Ibid , p. 380.

civilizations from southern Iraq to its centre and then to its north by the impact of these climate changes.

One of the most important reasons that contributed to the change of the course of the Euphrates is attributed to Aasef Al Dawleh the vizier of Nasir-ud-Din Muhammad Shah in the late eighteenth century. He intended to construct a bayou to deliver water to the city of Najaf, taking water from the right bank of the Euphrates, known as the Indian bayou (Shatt al Kufah). It expanded at the expense of Shatt al-Hillah, until it became the main course of the Euphrates in the late nineteenth century<sup>15</sup>. Another reason for this transformation was the accumulation of sediments in the basin of the Babylonian stream, particularly in Al Lamloum Marshes\*. The rise of the land of this area over time has led to its inability to absorb all the floodwaters, diverting water to the Al Hindiya branch<sup>16</sup>. As shown in map (2). The decline in land in Shatt al-Hindiya, Shinafiyah and Samawah had the greatest impact in accelerating this shift.

The Euphrates tends to change its course to the west. This can be inferred from the fact that most of the twists and turns of the Euphrates prevailing in the study area that creep westward and south-west, as well as fold seams in the area, which are remnants of the ancient Euphrates, during its runoff in those areas.

(Map 2)

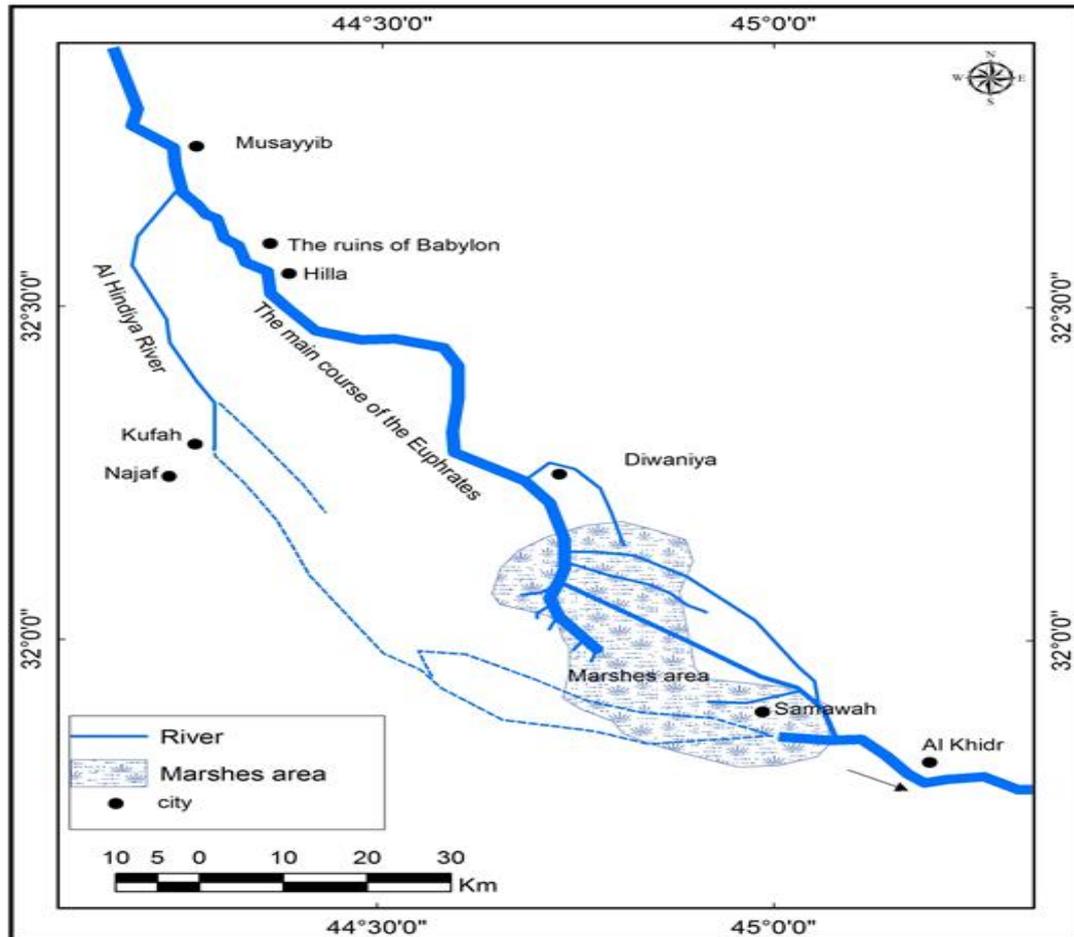
Development of Al-Hindiya River from the main course of the Euphrates

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<sup>15</sup> Mahmoud Shukri Al-Alusi, Hilla City in Baghdad News and Neighboring Countries, Al-Mawdid Magazine, First Issue, Ministry of Information (Iraq), 1975, p. 113.

<sup>16</sup> Naguib Kharofeh and others, Irrigation and Desalination in Iraq and the Arab World, University of Baghdad, 1984, p. 136.

\* Al Lamloum : A group of clans of different origins gathered in the area between Samawah and Shamia.



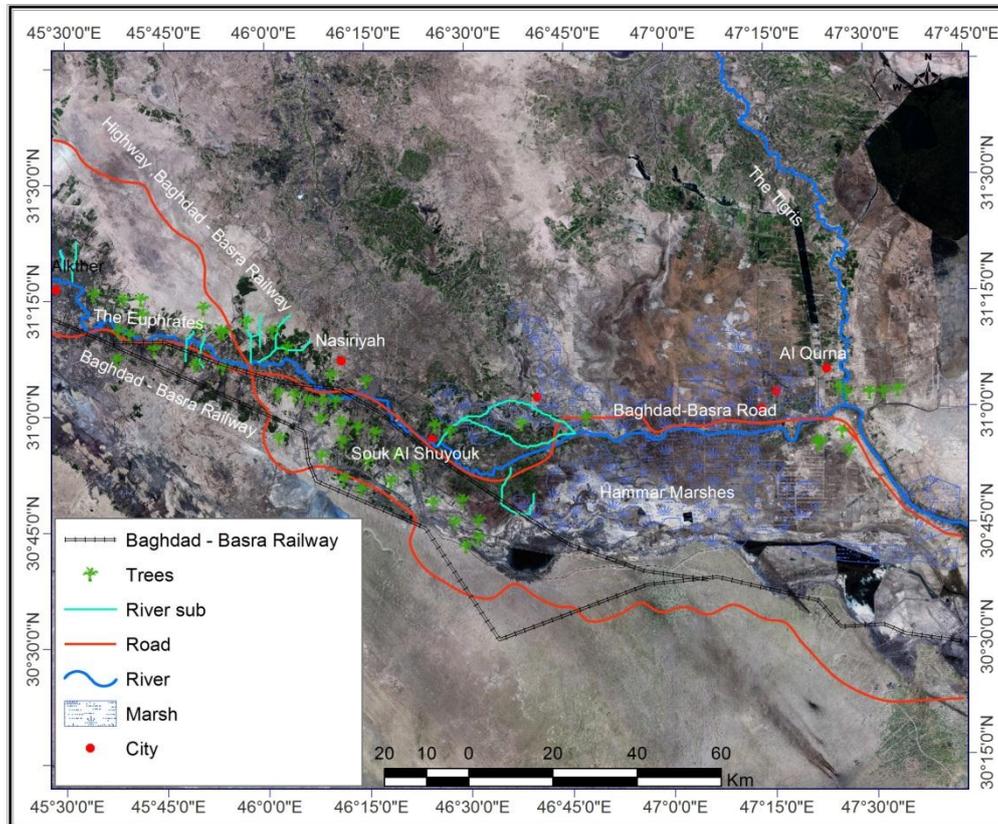
Source: Ahmed Sousa. The Euphrates valley and the Siddh al-Hindi project. The second part. First Edition. Al Ma'arif Press. Baghdad. 1945. p. 209.

The river has also been abandoned its course several times, taking new courses to the west. See satellite image (1). The course follows geological weak areas that arose due to extreme horizontal movements caused by the movement of the Arab, Iranian and Turkish plateau, and the stability of the course above some of the schemes that determine the areas of weakness on which the course settles.

This is evidenced by the fact that the course takes a closer approach to straightness in some sections, demonstrating that the area is tectonic, as well as the development of the natural course in terms of the large quantities of sediments carried by the large number of craters and deposition at the bottom of the course, besides the development of the lands of the Euphrates Delta in terms of lack of descent, and human activities and civilizational conflicts that took different forms over the

lands of the sedimentary plain (flood plain) And the consequent neglect or interference in favour of the course of the Euphrates or against it.

### Satellite image of the study area



Source: Ministry of Water Resources. Engineering Designs Department. Unpublished information.

### Summary

The status of the Euphrates is not as it was in ancient times. There have been changes in the characteristics of its course during the current century. They are limited and continuous changes due to the lateral movement of the river within the Floodplain area, which reflected its effects on the features of the river and its morphometric dimensions, which changed from one period to the next, as folds, river islands and the extension of the banks. All of which depend on the river drainage system and its natural load and climate factors affecting it, as well as human intervention in water discharge of the river.

The continued state of tectonic activity in the southeastern and eastern regions of the region in the form of waves of elevation is offset by activity in the subsidence operations in some areas, which led to the transformation of river course of the Euphrates in the area between Souq Al Shuyoukh on the one hand and Qurna and Zubayr on the other about three times, breaking in one of these times Hammar Marshes. The study has proved that there are many extinct river streams, whether they represent the main streams of the Euphrates or its branches in the long historical periods before it changed its course.

It can be said that the Euphrates River is characterized in the region by the large number of sharp deviations in its course due to the dominance of the linear structures that intersect with the course of the river in several locations, especially in the area between Al Khidr and Basra.

The natural factors of modern tectonic activity, high base level, rainfall, as well as human factors and recurrent flooding along the riverbed were important factors that changed the course of the river to the south-west.

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