

# Geographical history of exploration and drilling for oil in Iraq

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## INTRODUCTION

Iraq is one of the world's major oil suppliers, oil reserves estimated 143.1 billion barrels, and Iraq located in the fourth rank of list oil countries according to the oil reserves amounts.

The structural study includes an introduction and two main axes first one: Geological structure of Iraq, the second one prospecting, exploration and drilling for oil wells.

The drilling of oil is one of the major things in the oil industry. It is the vanguard of the fundamental activities and actions which are indispensable to find oil and extract it. The drilling of oil precedes any of the other stages in oil working, as well as exploration activity, it is an important and essential component for the development of the oil industry. Without the addition of new reserves production rates cannot be sustained and lengthened.

The process of exploration is associated with scientific and applied progress. The relationship between them is ejective, whenever the means of detection and drilling are developed; in turn the exploration process becomes successful and fruitful. Finding oil in the ground and determining its quantity, quality and the existing reservoir circumstances such as temperature, pressure, porosity, permeability and the preparation of the field for production and development, is all based on the process of exploration. Thus we find that the process of oil exploration is a comprehensive tool for the use of applied science and technical means in a coordinated manner, all of them take their place in order to find oil.

On the other hand, we find that the understanding of the geological structure in Iraq and the realization of its development is very important in practical exploration. Whenever the geological structure is interpreted correctly, it helps to detect

oil reservoirs and determine their concentration; moreover it can be used by specialists in this area to give their decision on the drilling of exploratory wells and the future expectations in finding a large number of oil reservoirs.

We can conclude from the above mentioned point, that exploration begins by reviewing all the available information for the area to be explored, in terms of geological structure, installed faults, cracks and other geological phenomena that play a role in the formation of oil or in its emigration or absence, so we find that geological studies have great significance at all stages of exploration, drilling and the development of the field. We must study the geological structure of Iraq and see the status of its geological structure, so that we can interpret the focus factors of oil in the specific areas of Iraq or the absence in other areas of it, as well as identifying oil reservoirs and the varying quantity and quality of oil in a reservoir or within these fields

## Geological Structure of Iraq

The study of the geological structure of the rocks in the earth's crust has great importance in the field of economic geography, because of its direct impact on economic production, especially the distribution of minerals and rocks that contain metallic and nonmetallic metal. Geological times are divided into eras and each era has special markers, a knowledge of which helps to find out the breakdown of metal production and to identify areas of focus major minerals A correlation is observed, for example, between metallic minerals such as iron, copper, lead, nickel and chrome bullet veins and deposits of coal which are stretched within the earth's layers that were affected by Alhersinah torsion movements in the late stages of the coal era and the early Permian era. When looking at the geological structure of the Middle East in terms of the structural view, we

see that Iraq is located within the unique scope of general tectonics for this region, specifically between the rock shield of the Arabian Peninsula and the Iranian plate. This scale is characterized by factors of favorable and effective geological conditions for the formation of a sedimentary basin, which is large and rich enough to form oil and assemble it in structures and giant fields.

If we want to study the geological structure of Iraq we must mention some of the geological theories that have tried to shed light on some present geological aspects, theories regarding oil are the most important of them, in an attempt to explain their causes. It also should be pointed out that the geological history of Iraq is linked closely with the old sea "Tethys and its development.

There are many geological developments that occurred during the period between the Cambrian and the fourth era, 500 million years ago. The most important of those developments was the flooding of the Tethys Sea, which covered almost all Iraqi land with water. After that a lot of layers of sedimentary rocks, with a thickness range around (50) thousand feet, were deposited. These sediments covered almost all areas of Iraq. For instance the alluvial plain area was covered with deposits of the fourth era. While a spreading of deposits of the third age and the second age occurred in the northern and western regions, which are located near rocks which are older. There were deposits of the first era in the far north eastern and far western regions of Iraq. The distribution pattern of these sediments graded whenever we moved away from the alluvial plain to the north-east and to the west on the other hand. This is consistent with the flooding and the retreat the waters of the sea. After the sea shrank, leaving the sediments which had an impact on the age and type and quantity of the natural resources in it.

New studies indicate that the sea has the advantages of geosynclinal formation stages, as it was composed from a series of deep- sea trenches and volcanic islands in parentheses, which are run along these trenches. In its first stages, limestone was deposited in its internal parts while the other parts were a mixture of calcareous rocks and igneous rocks resulting from volcanic lava inside the sea, as well as the fossils of invertebrate Alradiolria animals.

We can conclude from the previous points that the land of Iraq was covered by the waters of the sea (Tethys) and after geological changes, the retreat

of the water of this sea left deposits of membership, which are the remains of marine organisms that disappeared within the earth, this may be the primary cause of the oil, especially after its exposure to great pressure and temperature.

This conclusion was in accordance to the organic theory of oil which is developed by (Lomotsov) in 1763. He was the first to put forward the idea of the organic origin of oil. In spite of the differences between the theories that explain the organic origin of oil, especially in the interpretation of the installation of the original material, the terms of its collection and factors of transformation. However, all these theories agree to emphasize the organic nature of the original material and its close relationship with sedimentary rocks, and the appropriate conditions for the transformation of the buried material in the sediments crust into oil. This led the scientist Vasuevts to say that the theory of the origin of oil is not a theory of membership only, but it is a theory of (membership ,sedimentary and emigration) . The theory of the organic origin of oil suggests that its origin is due mostly to the organic detritus of animals and plants that lived in the water such as (Plankton) or at the bottom of water basins, such as benthic, as well as the germs (bacteria) that played a big role in the compilation of the organic material and its deposition under water. The decay of vestigial organisms is considered as an inevitable stage in its transition to oil, but the chemical components in these organisms are different in their contribution to this shift. There is another theory explaining the emergence of oil which points to it being the result of chemical reactions in the ground between inorganic materials, this theory is called the inorganic theory.

Great geological events, including the changes in the dry land and water, changes in the climate and the occurrence of vertical movements that composed the continents and mountains, causing fractures and cracks have occurred on Earth since its intransigence in the era before the Cambrian until the present time. Geologists divide this date into times and the times into epochs, and the epochs into eras, and every age is different from the others in the type of rocks, the degree of the height of the dry land, its plants and animals, the climate and the minerals that have been formed in the individual geological eras. Others were formed in more than one age, as is the case with oil, for

example in the deposits of the second and third times.

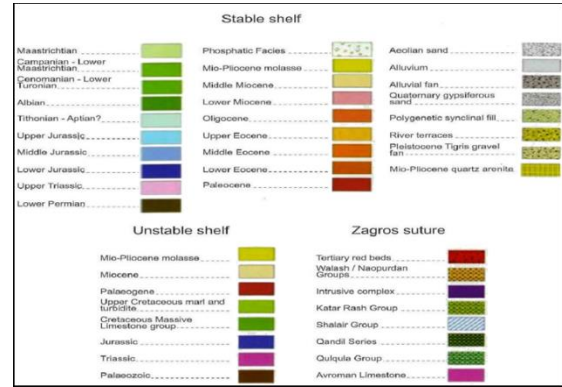
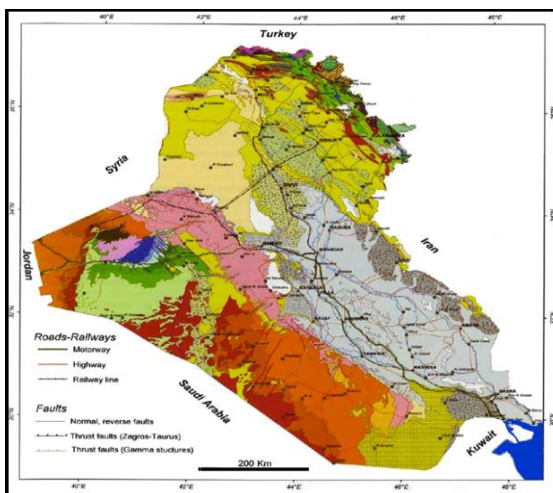
During those periods the area was covered by the Tethys sea which was exposed to ground factors erosion and weathering which formed in the form of successive layers and coherent to be " sandstones the mud-rock limestone ".

From this we can conclude that the general geological situation for Iraq is along the axis of the Tethys basin near the movement of the Zagros Mountains that made oil emerge in the origin rocks, which concentrated in the geological formations under the surface.

These compositions and oil reservoirs have not come in one geological time, but it was formed through successive geological eras and each oil basin has special geological conditions.

Generally, we can form a link between the date of the oil in Iraq, its migration, its gathering and the movement of the first sediments in the basin, and it can be divided into the following Geological times ( Map No.1):

- 1- pre-Triassic (Permian – Alardfeache)
- 2- Triassic.
- 3- Jurassic.
- 4- Cretaceous.
- 5- Triple, especially in the Eocene and Miocene.



Map 1: Geological structure of Iraq

Source / Saad Z. Jassim and Jeremy C. Goff, Geology of Iraq, published by dolin, prague and Moravian museum, brno, 2006, p.25 .

Iraq is a part of the major oil basin that covers most of the territory of the Levant in general and the Arab Gulf region in particular. Oil basins are spaces of lands that tend to unify and there are similarities in their general appearance of Geology and Geography, in spite of a clear diversity in some of their constituent parts. And its parts contain multiple oil fields forming the hotbeds of current production and the oil fields need certain conditions or factors for their formation, these factors are:-

A - A suitable geographical environment for the growth of living organisms .The Sea should be adequate for life, then death and then it should be buried in the seabed under thousands of tons of sand. In this respect, we find that Iraq has the ideal conditions, especially since the water of the Tethys Sea has covered most of the territory which became an important geological center to form oil.

B - The presence of porous rock Layers allowing the movement of oil between the pores such as sandstone and limestone rocks. The former rocks cover most parts of the southern basin (alluvial plain), while the latter cover all parts of the northern basin of Iraq, a hilly or semi-mountainous region. Igneous rocks are seen on the far North East sides (high mountains) of the remains of the basin. The area's potential oil reserves, in addition to the existence of the reservoirs or traps that create spots which help oil to collect at different depths.

When we study the geological distribution of Iraqi oil, we find that the Tertiary strata contains a proportion (23%) of oil reserves and about (76%) in the Cretaceous and the remainder (1%) in the Jurassic and Triassic.

## Prospecting, exploration and drilling for oil wells

Oil was known in Iraq and was used before 5000 BC. Iraqi ancestors (Akkadians, Sumerians, Babylonians and Assyrians) used tar in different areas, and ancient writings refer to them as the eternal fire. The Sumerians used tar in sculpture and as an adhesive material in the building boats and houses and as a construction material as well as using it in old weapons. According to the discovered Antiquities, the Assyrian king Sennacherib (704-682 BC) used tar for paving the course of a river. The Greek historian Herodotus (Herodotus) (484-425) BC, described the city of Hit, which was located in the Upper Euphrates River in Iraq, as being surrounded by wells and springs of tar, and benefited from it during the construction of ancient Babylon. The Babylonians used oil in paving walls and also used it in Surgery and Medicine, one of British travelers confirmed that, when he described the Tar eyes of Heat city, he said that "there is a black substance out in the form of big bubbles it use in paint boats and any one it can be hearing the sound explosion of it, for a distance more than a kilometer."

It is indicated that oil was used in lighting the lamps of the Kirkuk region, about 3000 years ago, and it was extracted and filtered through primitive ways in the areas of Mandali and Baba Karkar. In addition to its use for medical purposes, as the Bedouins continue to use it to treat skin diseases, it was also used as fuel and in the weapons industry. Not to mention the evidence of the presence of oil, such as the eternal flame of gas that leaks out of the ground, which proved the presence of oil facilities for natural gas. In the seventh century AD, Arabs and Muslims used oil in their conquests towards the east, especially "in creating fire Blocks for catapults and in making boiling tar for the defence of castles and forts, by putting it in pottery to prevent the penetration of the doors of the castle wall", they also it used in their working lives, and it was used by the Abbasids as a means of illumination.

When looking into the history of the research and exploration for oil in Iraq, it is also important to identify the political history of this country and its relationship to oil, because Iraq was occupied by successive empires (such as Mongol, Persian, Ottoman, the British and the United States of America). These empires and invading countries formed a part of its political and economic history. Most of these forces were interested in the wealth of Iraq, or in its geo-strategic or natural and human potential, most recently the U.S - British

occupation of Iraq after 2003. Oil was the major cause or a strategic factor in the occupation, in addition to other strategic objectives of the invasion, including regime change and re-ordering the balance of power in the Middle East and elsewhere.

Prospecting and exploration for oil in Iraq began when it was a part of the Ottoman Empire, which colonized Iraq for 386 years, for the period 1532 to 1918. The discovery of oil in Iran (the Mosque of Solomon) stimulated efforts to search for oil in Iraq. Research efforts focused in the Mosul area.

The first attempt to explore oil in Iraq was in the reign of the Ottoman governor (Midhat Pasha) from 1869 to 1872, and that was in the late nineteenth century as was the exploration for oil by a German Mission in 1871. Midhat Pasha brought the mission to build an oil refinery in Mandali. The German bank gave the Ottoman state two loans, they totalled about 2,640 million Turkish lira. The Germans were among the first who were interested in oil in Iraq and made great efforts to engage in this area. This drew the attention of the Ottoman Sultan Abdul Hamid II (1876-1909) to the importance of this material, therefore in 1882 he ordered the annexation of the territory of Mosul oil, including Qayyarah to his private property, and limited this under (edicts) issued for this purpose, (concessions of oil exploration and exploitation in the states of Mosul and Baghdad become his private property).

In 1899 Germany won the concession to extend the railway line (Baghdad - Basra). Then another mission came to confirm the presence of oil in Iraq in 1901. Between 1871 - 1901 the two German Missions were an essential turning point in oil exploration. On the basis of which the Germans were enabled to obtain an edict from the Ottoman Sultan by the convention of the railway line (Baghdad - Berlin) in 1903 that authorized the right to prospect for oil on both sides of the line, Thus, this edict or resolution was the first step to get the concession for oil investment in Iraq's history.

According to Longrigg, in his book ((Middle East oil)), this mission submitted a very optimistic report, but the man who brought attention about the oil in Iraq was (Calouste Gulbenkian). He submitted a report to the Ottoman sultan. This report confirms the existence of oil fields and the possibility of investment of these fields by foreign capital. Because of its impact, the Sultan issued a decree stipulating that the financial revenues of

the Iraqi territory from the resource of are returned oil to his treasury.

Britain tried to obtain monopoly in Iraq's oil but it did not withstand the influence of Germany. Attempts by Britain to have this privilege did not stop until a constitutional coup in Istanbul, then oil talks stopped in 1908, but they returned in 1910 and its result was the establishment of the National Bank of Turkey which was able to finance the projects of British capital. This bank had been able to obtain a significant share of oil in Iraq. Then the United States came to be a strong competitor to the Germans and the British in control of Iraqi oil. As a reaction to this competition the Germans and the British united in their efforts and the parties agreed virtually to form a company which would sponsor their interests in 1911. It was named the African and Eastern privileges Company Ltd. and then re-created in 1912 and when it was renamed the Turkish Petroleum Company Ltd. The latter managed to get the right of oil investment in the states of Mosul and Baghdad in June 28, 1914, in accordance with the decree issued by the Turkish Grand Vizier. The ambassadors of England and Germany were told that a special note states that "There is a concession which has been given to the Turkish Petroleum Company to invest in oil in the states of Mosul and Baghdad," This note which was issued by the Grand Vizier of the Ottoman Empire to the ambassadors mentioned has a paramount importance in the history of oil investment in Iraq, as it subsequently became the only historical document which the Turkish Petroleum Company bases its claim of the right to oil in Iraq. The quotas or shares of contributing companies in this company were different and shared by each of the oil companies, the English which have about (50%) of the shares of this company which was the highest percentage of shares see Figure (1), and the German Bank (25%) and Royal Dutch Shell company (25%).

Name of company	percentage for shares company
Anglo-Persian Oil Company	50
German Bank	25
Royal Dutch Shell	25

Table 1: The percentage of the shares in the shareholding companies in the Turkish Petroleum Company: *Source / Arabian American oil co.: Middle East oil development, 4th Ed. New York. 1956, p. 25.*

Within weeks of signing the contract, the First World War broke out and Britain rushed to the occupation of Iraq in order to keep the Germans

from being in the Middle East and to prevent them from seizing Iraq's oil.

In this period, there was a conflict between Britain and Germany regarding Iraqi oil, but on the other hand, their cooperation resulted in the removal of the U.S. influence, but the establishment of the First World War prevented the Turkish Petroleum Company from beginning its work in the exploration and the search for oil.

After Britain suffered a military defeat to Turkish troops in the Kut area in central Iraq in 1916 Britain hastened to ask for help from France, then the parties agreed to extend their influence over large areas of the Middle East, including Iraq, according to a treaty (the Sykes - Picot) in 1916. Mosul was the price to entice France to provide military aid to Britain, as well as this France stipulated a proportion (25%) of the Turkish Petroleum Company for approval to extend pipelines to transport Iraqi oil through the waters of the Mediterranean Sea, then France got a proportion (25%) of Iraqi oil as well as other decisions relating to the organization of Iraq's oil investment.

After the founding of the Iraqi government on 23/08/1921 the Turkish Petroleum Company made a note to the Iraqi government under the ministry of (Abdul Mohsen Saadoun), alleging that the Ottoman government had given the company a concession to extract oil in the states of Baghdad and Mosul in 1914, and the company wants to proceed with its work to explore for oil, despite the fact that the Iraqi government refused to recognize this right, but it fell on its decision after pressure from the British government on the Iraqi government.

Thus, the Turkish Petroleum Company managed to obtain the right of oil exploration in Iraq, according to an agreement signed in 1925, the term of this privilege was 75 years and covers an area of 192 square miles. According to this agreement the Turkish company was granted the right of exploration, extraction and preparing for trade, transport and distribution. As well as this the company undertook to pay royalties as a concession to the Iraqi government which reached 4 gold shillings per ton produced from crude oil for a period of 20 years, and this oil was to be supplied to Iraq at a fixed price. The Iraqi government required that the company should lead the process of a widespread geological survey taking eight months in the three areas which are

within the basin of northern Iraq's oil. In fact the Turkish Petroleum Company made several important discoveries, such as the discovery of the fields (Kirkuk, Jambour, Bai Hassan).

1927 witnessed unusual exploration activity in Iraq, as in April the drilling of the Blkana installation near the city Tuz Khurmatu, south of Kirkuk, was beginning. However, the drilling stopped before reaching the oil reservoirs. In May, drilling began in the in the oil field Injana and Khashm Ahmar which was situated in the middle part of the Hamrin mountains, but drilling was also stopped because gas under high pressure was found in them before the oil reservoir in them was reached. As well as that, the main reservoirs of the Qayara field were penetrated in the same year, followed by the discovery of oil in large quantities within the giant Kirkuk field. It was the first huge discovery in the Middle East it was the most important discovery of oil in Iraq's modern history, on 7 October, 1927 quantities of crude oil and gas coupled with the sound of thunder rushed violently to the surface. This is what was called by the oil workers as "starting violent", which means a loss of control over a burning oil well, and quickly the oil immersed a rural area, and a cloud of dense gas filled the air, and the well was out of control for nine days. As a result, the Turkish Petroleum Company (Iraq Petroleum Co., Ltd.) inaugurated a drilling campaign of wells, but despite this production of commercial quantities of oil did not begin until 1934, after agreeing to extend two pipe lines, the first line (Kirkuk - Haifa) and the second line (Kirkuk - Tripoli).

Following the great explorations by the Iraq Petroleum Company Ltd., in particular those carried out by the company's exploration work in the Kirkuk field, specifically in the Dome (Baba Gurgur), this company demanded from the Iraqi government the lengthening of the limited duration of the aforesaid convention, and also demanded the right to choose some additional areas in Iraq to carry out exploration. The Iraqi government suspected that the company wanted to control Iraq's oil wealth, so Iraq insisted on not prolonging the specified period in the areas mentioned in the convention. After that the company dropped its claims at the insistence of the government and the Iraqi public. Despite all efforts, the Turkish oil company was able to provide some new proposals that aimed to alter the Convention in 1925, and then the Turkish oil company changed its name to Iraq Petroleum Company Ltd (IPC) or (IRAQ PETROLEUM

COMPANY) in June 8, 1929, this company was taken over by Britain and came to work in its favor. Beside the Iraq company Ltd, there were other companies with the task of oil exploration and investment, as part of specific agreements for the right to explore as follows: -

**First:** - Turkish oil company or the Iraq Petroleum Company Limited:-

Formerly, the concession area was Mosul and Baghdad - just east of the Tigris River Map No. (2), the duration of its concession was 75 years with effect from 14/12/1925 and ending in 2000, and an area of about 32 thousand square miles, and the shares of this company is distributed as follows: -

- 1- Anglo - Persian Oil Company (later renamed British Petroleum BP)"" (D'Arcy Exploration limited Company which have a percentage (23.75%).
- 2- Anglo Saxon Petroleum Company (Royal - and Shell) have the ratio (23.75%).
- 3- U.S. oil companies group, including (New Jersey, Standard Oil and static - Facum) ownership percentage (23.75%).
- 4- French oil company (later renamed Total CFP) ownership percentage (23.75%)
- 5- Calouste Gulbenkian "Cooperation and Investment Company Ltd ownership percentage (5%).

As can be seen in Figure (1) the companies have shared this stock with each other in accordance with agreements made between them, these parties have sought to get the first oil concession from the Iraqi government.

**Second:** Mosul - British Petroleum Company Ltd: Founded in 1928 in London to get the Iraqi oil in Mosul, formerly its franchise was the west of the Tigris and north of latitude 33 degrees See Map No. (2), and the duration of its concession was 75 years, with effect from 05.25.1932 and ending in 2007.

**Third:-** Basra, British Petroleum Company Limited: - previously its franchise was Basra and southern Iraq, including the territorial waters and islands within Iraq's share of the neutral zone (Iraqi - Saudi Arabia) for a duration of 75 years with effect from 11.30.1938 and ending in 2013

Fourth: - The Khaniqin Oil Company Limited: - In addition to the three companies mentioned above, there was the company of Khaniqin, which was

formed in 1925, which is in fact a branch of the company Darcy Oil Company (English – Farsi). The extraction of oil for this company is the territory of Khana oil which is located in Khaniqin and Mandali, near the Iran-Iraq border ( Map No.2), and an area of monopoly covering 2080 square kilometres, while the period of concession was 75 years, with effect from 08.30.1925 and up to the year 2000, the company extracted oil from its concession and filtered it in the refinery (al-wand) near Khaniqin, particularly on the left bank of the River Al-wand

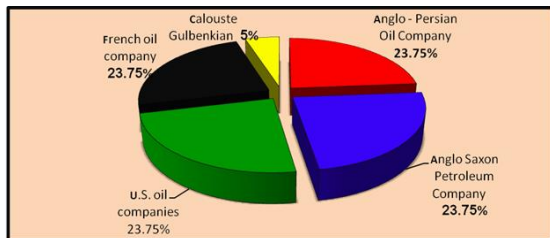
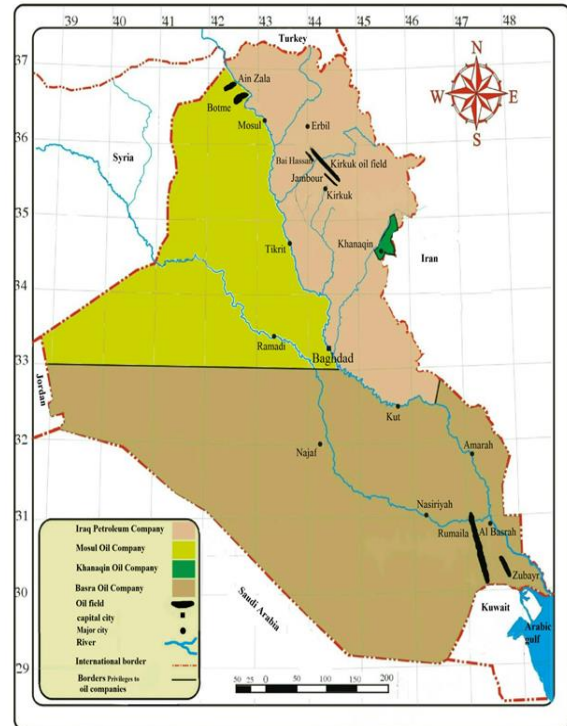


Figure 1: Shares of joint stock companies in the Iraq Petroleum Company Ltd. Source / researcher based on the information received previously.

After this stage, the United States sought to receive a share of Iraqi oil, they were looking for an open-door policy at that time, in other words this would leave free competition between companies to get concessions and France did not accept this because of its inability to compete with Britain and America.

Negotiations began with France and Britain, and ended with the signing of the Convention (red line) in 1928, which laid the foundations for the ultimate compatibility for oil concessions in the Arab Levant.

Through the above, we find that the First World War created a historic change in the scene of the Iraqi oil, especially after the insistence of the United States to follow the policy of reciprocity in the case of oil concessions, which came in response to the reluctance of the European oil companies in acceptance of American companies in the arena of Iraqi oil. More than this, the United States announced that it would not recognize the privilege of the Turkish Petroleum Company and this resulted in a series of negotiations between the parties. During this period, the U.S. companies formed a bloc, including a group of oil companies which would be able to withstand the British



Map 2: Privileges of the oil companies in Iraq before the passage of the Law 80 in 1961 and beyond: *Source / action depending on the researcher: Mohammed Azhar Al samak ,Iraqi petroleum between the foreign control and national sovereignty, (analytical study in resources of economic wealth ) Ministry of Culture and Information, Mosul, 1980, p 60.*

interests in the exploitation of Iraq's oil. In front of American pressure, Britain responded to the demands of American companies and decided to be involved in Iraq's oil.

In 1926 the Khanaqin Oil Company managed to obtain an oil concession in the khana oil field: an oil field sharing a border with Iran. This field was one of the subjects that formed the continued dispute between the Turkish Petroleum Company and the Oil Company, Anglo - Persian since the discovery of oil there, as this field extends into Iranian territory and there is a so-called "oil Shah". The main conflict about this is that investment in either country will affect the stock in the territory of the other State.

After the settlement of the problems with the Iraqi government, the Turkish oil company went to northern Iraq, particularly the oil rich fields of Mosul and Kirkuk. The team of geology companies shared directories based on the phenomenon of leaking gas and oil.

The shareholders in the oil companies were able to develop a complex mechanism with new conditions to guide the Iraq Petroleum Company in

1948. This condition based on the necessity of estimating the shareholder's oil needs (owner of the shares in the company) for five years. This oil is processed by the delivery ports of the contributor on the Mediterranean ports or the Arab Gulf at the cost of production, due to the fact that the Iraq Petroleum Company was organized on the basis of not-for-profit, so that the processing is equal to the shareholder's share in the capital only. While the excess demands exceed the shareholder's share of the partners' shares, which are not depleted of Iraqi oil, and are priced on the basis of the difference between the cost of production and the advertised price of oil in the port of delivery. The Iraqi government became an inactive recipient of oil revenues.

The control of Iraq's oil by oil companies and at all stages of the oil industry, like the rest of the world, led to the failure of the entire oil sector. In spite of all that, the period between 1923-1950 experienced important oil discoveries, especially after the exploration process had grown. At first we find that the attention tended to be focused on exuding, leaks of oil and the surface features of the oil fields in Iraq, but the use of this evidence did not bear fruit in other areas, which led to the use of gravity surveys and primary seismic surveys to determine the areas of installation, also the Geological Survey was used for the first time in Iraq in 1948. In southern Iraq, the first two fields in the region were discovered, which are called the Zubair and Nahr Omer. Look Table No. (2) Which shows the oil discoveries of the period (1923-1950): -

Field Name	Date of discovery	Reserve (billion barrels)
Naftkhana	1923	0.3
Kirkuk	1927	22.4
Oaivarah	1927	1.00
Khashm al ahmar	1929	0.15
Kanuqah	1929	0.10
Najmah	1934	1.25
Sadid	1935	0.10
Qasab	1936	0.75
Qalian	1936	0.10
Jawan	1937	1.00
Adaivah	1938	0.10
Ain Zalah	1939	0.20
Zubair	1949	4.75
Nahr Omar	1949	6.27
Ratawi	1948	3.00
<b>Total</b>		<b>41.47</b>

Table 2: The important fields that were discovered in the period 1923 - 1950 and its oil reserves Source / researcher based on:

1- Oil production capacity in the Gulf, volume 4, Iraq, book3 (London: CGES, 1997).

2- Muhammad Ali Zaini, (oil and gas sector in the Gulf region the possibilities and limitations) - Iraq's oil sector: future scenarios, edition 1, Emirates Center for Strategic Studies and Research, Abu Dhabi, 2007, p 131.

- Numbers of oil reserves here are estimated and vary according to the estimation method or the method used in estimating reserves.

Then, the giant field (Rumaila) was discovered in 1953 in the same way (Geological Survey) as well as other discoveries in the north of Iraq, including the fields of Bai Hassan near Kirkuk and Botme and in north western Iraq near the field of Ain Zalah in Mosul. The process of deep exploration continued and led to the discovery of the Jambour field , which was located in Kirkuk, and the Brick and Allhis fields in the south during the period 1955 - 1961, see table (3).

Field Name	Date of discovery	Reserve (billion barrels)
Butmah	1952	0.10
Bai Hassan	1953	2.50
Rumaila north and Rumaila south	1958-1953	27.25
Kor Mor	1953	0.10
Jambur	1954	0.50
Ousair	1954	0.10
Atshan	1955	0.10
Allan	1955	0.10
Sargon	1956	0.10
Makhul	1956	0.10
Rachi	1957	1.00
Ibrahim	1957	0.10
Imianah	1958	0.25
East Baghdad	1958	0.10
Tuba	1959	0.10
Samawah	1959	1.00
Pulkhanah	1958	0.10
Demir Dagh	1960	0.10
Chamchamal	1960	0.10
Kifl	1960	0.10
Hamrin	1961	1.75
Al Luhavs	1961	1.00
Qarachauq	1961	0.10
Al Duailah	1961	0.10
<b>Total</b>		<b>36.85</b>

Table 3: important fields that were discovered in the period 1950 - 1970 and its oil reserves Source / researcher based on:

1- Oil production capacity in the Gulf, volume 4, Iraq, book3 (London: CGES, 1997).

2- Muhammad Ali Zaini, (oil and gas sector in the Gulf region the possibilities and limitations) - Iraq's oil sector: future scenarios, edition 1, Emirates Center for Strategic Studies and Research, Abu Dhabi, 2007, p 132.

In 1958 the property in Iraq was replaced by the republican system. The new government conducted a thorough study of the provisions of the privileges and problems arising from them. Negotiations were conducted with the Iraq Petroleum Company, for the purpose of interest in the oil industry and the possibility of exploitation of oil for the benefit of the people in Iraq and the reduction of control of the oil companies on oil operations, whether for exploration or extraction or export.



Law No. 80 was issued in 1961, by which the withdrawal (99.5%) of Iraqi territory which was under the concession agreements, due to the failure of the monopolistic oil companies in the exploitation of them, and it kept oil fields under production, such as the fields in South Rumaila, Zubair, Kirkuk and Ain Zala. We can examine the most important features of the law (80) as follows:

1- Investment in non-producing fields and other fields in which oil discovery is expected, by the Iraqi National Oil Company through direct investment without the need to give the foreign investors involved long-term contracts, especially in southern Iraq, because of the proximity of the southern fields from the export ports, as well as the extensive oil and the quality and intensity in these fields.

2- Surveys are not limited to the land which has oil, it should also be included in the waters of rivers, lakes and marshes as a part of the process a comprehensive survey of the oil wealth.

3- The law was able to make a balance between the needs for funds and the national desire to prevent foreign companies from stealing oil wealth, through the expansion of production or the increase of it by signing employment contracts and management with other companies working to calculate the national oil company.

4- To achieve integration in the oil industry through oil production, refining, transportation and export of it to the outside world, and then marketed it through agreements or by long-term business contracts, and the establishment of Petrochemical Industries

Law No. 80 included withdrawing unproductive layers in those fields; also it paved the way for the establishment of the Iraq National Oil Company, which issued the law for its establishment on February 8, 1964. It initiated the preparation of its formations and began development operations. The following table shows the areas that were exploited by oil companies operating in Iraq under Law No. 80 for the year 1961.

Company Name	Privilege region	Area km <sup>2</sup>
Iraq Petroleum Company	Kirkuk	478
	Bai Hassan	182
	Jambur	86
Mosul Oil Company	Ain Zalah	45
	Butmeh	16
Basra Oil Company	Rumaylah	568
	Zubair	559

Table 4: Areas that were exploited by oil companies, according to the law No. 80 of 1961 *Source: Zamen Rawy sultan Husain AL-Juboory, The reality of the oil policy and the methods of repair it In Iraq, Master's Thesis submitted to the Faculty of Administration and Economics, University of Kufa, 2010, p 19.*

It has been determined that the size of the proven reserves was 34 billion barrels; this was as a result of the exploration and geological survey, and gravitational and magnetic surveys. The discovery of 62 complexes, 35 fields of them have been proven with a success rate of 56%, which is high globally. In 1966, after the establishment of the Iraq National Oil Company, the company re-evaluated the results of the surveys and studies that were in the possession of concession companies, and included about 215 thousand square kilometers in the southern regions (except the producing areas in the Rumaila and Zubair) and under which it was identified that about 300 geological complexes through gravitational and seismic surveys, from that 135 complexes were identified as having potential for the presence of oil and gas. The size of the oil reserves reached 350 billion barrels and the size of the recoverable oil was 111 billion barrels.

It is noted that the goal of the exploratory activity of foreign companies in Iraq before the nationalization had been limited to exploring the number of oil fields that could meet the production target at that time and specified within the strategy of the companies for the distribution of oil production from the areas of its operation inside Iraq.

Law No. 97 was issued in 1967. This Law prevented the exploitation of the territory of Iraq through the concessions of oil companies. After 1968, exploration processes expanded and the place evaluated by the organs of the Iraqi National Oil Company with the help of international companies, especially from the Soviet Union and France, where 72 billion barrels were added to the number previously approved, through the discovery of 52 complexes, proving 38 fields of them at a success rate of 73%. Because of the exceptional circumstances experienced in Iraq since 1980, the exploration and development remained within the required levels, delaying the processes of identifying new reserves. Briefly, we can include some details to give a complementary picture of the oil situation in that period in Iraq, we note the following figure: -

Oil compositions that discovered	525
Oil compositions that drilled in it	115
Oil compositions that wait drill	400
discovered Oil fields	80
Oil Fields that contain big reserves	43
Discovered Oil fields but it did not evaluated	37
Producing oil fields	15

From the above we find that law No. 80 from 1961 was an important event in the history of the oil industry in Iraq, especially after the oil exploration, but the liberation of oil was not completed in this law, because the monopolizing oil companies still controlled the exploration, extraction and export of oil, as a result the government decided to pass a law of nationalizing the operations of the Iraq Petroleum Company Limited (No. 69 of 1972) on the first of June 1972, which considered effective from the date of issue. The law led to the creation of a state company, it was named the Iraqi Company for Oil Operations and it oversaw the management of the oil company Iraq Ltd. It was then followed by the operations of the Basra Oil Company, in the years 1973 and 1975. The operations of the Mosul Oil Company were waived in favor of the national oil company in the Settlement Agreement that was formed on the first of March 1973. The national oil company increased significantly the number of the national seismic teams as well as drilling towers, which were occupied by fully national teams. However, in the late sixties and early seventies, Iraq collaborated with a number of countries in the fields of discovery and development, and the only three serious attempts were:-

1- The agreement with France (ARAB oil company limited), terms under which the development of three fields in the Maysan province (Bazerkan - field jaw - Abu west) and after finishing the job in 1979, the negotiation was repeated and replaced by public Convention for cooperation and did not entail any concession to the oil finder, to the contracting company. The company was compensated for what was spent on investments.

2- The agreement with Petrobras company in Brazil, under which the discovery of the giant Majnoon field occurred in 1979, also the agreement ended without incurring any obligations by the contractor company except compensation for its expenses.

3- An agreement with the Indian company ONGC for exploration (service contract) to an area in

southern Iraq, but it did not achieve the expected rate for productivity of the well, and then the contract was terminated as well.

4- At a later stage in 1974 the national oil company issued a call for a number of international companies to submit bids, on the basis of service contracts, but the Iraqi government decided through the process of evaluation of the offers, to cancel this policy and issued guidance to the national oil company to proceed with the policy of direct investment.

After the nationalization of the processes of foreign companies in Iraq during the period (1972 - 1975), and the assumption by the national oil company in active exploration at that time, the goal of the national exploration became comprehensive for all areas of Iraq to assess their oil reserves on one hand and to meet the rising rates of productivity on the other. The minimum of exploration Cost-effectiveness became an annual addition to the proven reserves. This addition was equivalent to the rate of annual attrition caused by the production. Exploratory activity was based on the direct national effort that increased up to 12 national seismic bands and 10 working foreign teams at the end of the seventies and early eighties of the last century, as well as about 10 towers for drilling exploration and evaluation.

National staff managed the activities of foreign companies that had service contracts with Iraq, such as (Arab) the French company and (Petrobras) the Brazilian company during the period 1969-1979, which resulted in their operations discovering fields (Majnoon, Bzarkan, jaw and Abu Gharb). The direct exploratory effort led to the discovery of other fields such as the neither fields Nor, Nasiriyah and Alahdab. See Table (5) which shows the fields discovered during the seventies of the last century as well as the amount of reserves expected in it, some of these fields were adopted by Iraq in oil production, as well as they were the most famous oil reservoirs in the world.

Field Name	Date of discovery	Reserve (billion barrels)
Abu Gharb	1971	2.35
West Qurna	1973	8.00
Jabbl foukqi	1974	1.50
Halfaya	1975	3.00
East Baghdad	1976	11.00
Khubbaz	1976	2.00
Majnun	1977	10.00
Ajil	1978	1.50
Noor	1978	1.00
Nasiriyah	1979	1.00
Other oil fields, each containing less than one billion		3.70
Total		45.05

Table 5: Discovered fields in the period 1970 – 1980

Source:

1- Oil production capacity in the Gulf, volume 4, Iraq, book3 (London: CGES, 1997).

2- Muhammad Ali Zaini, oil and gas sector in the Gulf region the possibilities and limitations - the oil sector in Iraq: future scenarios, edition NO: 1, Emirates Center for Strategic Studies and Research, Abu Dhabi, 2007, p 133.

The oil industry, particularly the movement of oil exploration in the seventies, witnessed a noticeable growth in the development of the fields and increase of production capacities and pipelines, whether for export or for the internal transport of petroleum products and liquid gas, gas and ports of export of crude oil in Turkey and the Arab Gulf, and the development of the potential of liquidation and the store of derivatives and gas industry.

Then, the Iraq National Oil Company focused on the assessments of the geological studies and the intensification of the geological and seismic surveys, and increased the number of teams, either foreign ones or national. Also there was an expansion of drilling exploratory wells, moreover conducting joint studies with foreign body's especially specialized institutions from the Soviet Union, France and others. Then the national oil company approved an ambitious plan to develop production in several explored fields. Many evaluation wells were dug, and cooperation with foreign companies specialized in the preparation of studies and tender documents of their own began. Specialized companies were invited to bid on a turnkey basis for engineering works and construction, and others for drilling operations on the basis of direct investment. The plan included the development of production up to 5.5 million barrels per day through the development of the following fields:

1- West Qurna field: in cooperation with the Soviet Union, the national oil company had already

signed and initiated contracts for drilling in 1981 and the contract to build the first phase (1988).

2- Majnoon field, which was discovered in collaboration with Petrobras of Brazil.

3- Halfaya field where it was preparing the tender for a field with the Agip of Italy Foundation.

4- East Baghdad Field, the tender documents for it was signed with the Italian Foundation (CFP) in French.

The most important operational procedures that took at that time were to sign a contract with the Brown & Root company in the U.S. to expand the export capacity of the Mina ' al-Bakr port on the Arab Gulf (now the port of Basra, deep) from the actual capacity of 1.4 million barrels per day to 2.4 million barrels per day.

Exploration and drilling saw a surge significantly after 1986 and especially after the first price boom for oil, as well as an increase of exploration activity, geological surveys and magnetism surveys, which added to the oil reserves about 38 billion barrels, to become 72 billion barrels, after it had been in the period 1927 - 1961 about 34 billion barrels.

In relation to the costs of exploration and development, according to the statistics of oil companies with a franchise in Iraq, it amounted to 26 cents per barrel on average operations in Iraq, including 0.1 cents per barrel in the south and 0.4 cents in the north-east of the Tigris River and 5.6 cents in the north-west of Iraq. While the cost of development, which includes the cost of wells and production facilities, was about one dollar a barrel on average for the three regions in Iraq under the same study.

According to studies prepared by the renowned expert Thomas Stauffer, his estimates for the cost of discovery and development is less than a dollar a barrel in Iraq, Iran and Saudi Arabia, but it is closer to a half dollar in Iraq, compared with (1-2) dollars to Kuwait and (2.5 - 3.75) dollars for the land fields in Abu Dhabi and about (6-7) dollars for the Marine fields in Abu Dhabi and (3-5) dollars in Venezuela. According to figures from the Iraqi National Oil Company, the rate of costs in the eighties did not exceed one dollar per barrel. However, now these figures must be higher than previous.

Later, those processes dropped sharply or stopped completely at some stage, where during the nineties there was less than one division / month

and there were no more than (2-3) working rigs, this had a negative impact on the reservoir behavior of produced fields as we will explain in a later chapter.

In (1990) stopped again effectively seismic surveys and exploratory drilling and evaluation and developmental, as well as the reclamation of oil wells and water injection wells, also fell and the number of geological, reservoir and engineering studies fell sharply because of a lack of information, poor communication with the outside world and lack of devices and equipment, and even spare parts. Many of the specialized staff had to leave Iraq due to political or economic reasons. The number of teams working on seismic studies before the war of 1991 reached 72 bands / month and the number of rigs was more than 20 towers and the percentage of the national seismic devices and excavation work which was managed nationally was more than 50%.

The political, economic and military conditions that prevailed in Iraq for the period 1991 - 2003 had formed a serious turning point, not only in the oil industry, and the movement of oil exploration, which is the subject of debate, but it disrupted economic activity for all fields of life, and all economic sectors (agricultural, industrial, services, trade and tourism). Iraq saw destruction of large oil installations after the first Gulf war and after the invasion of Kuwait, because the military forces that attacked Iraq were aiming to paralyze the economic movement and break the backbone of the Iraqi economy, which represents oil. The military operations in 1991 followed by the economic blockade or economic sanctions, which stopped investment operations in the oil sector, led to the demise of oil facilities and their equipment. Iraq had 30 seismic bands, but after the war had only 1 band, as the number of towers that were operating by Local labour hands fell from 20 towers to 3 towers. As well as this, the production of oil in Iraq fell from 3 million barrels per day to about 500 thousand barrels per day, which was enough to meet the requirements of domestic consumption, as the number of drilling rigs, which were more than 40 platforms before the war became 20 drilling platforms. The oil industry continued in this way, also the detection and exploration almost stopped for the period 1991-1997.

This sector remained under the weight of successive wars and the blockade, and resulted in complete paralysis in the wake of the war in March 2003. As the war of occupation completed the

destruction of what remained of the oil sector, not because of the war itself but because of the looting that occurred after the war and during it. Mr. Muhammad Ali Zaini ,an oil adviser who worked with the U.S. team between the months of May and August of the year 2003, described the damage which hit the oil sector, saying, "the damage caused to the oil industry was comprehensive in its nature, starting with the smallest equipment until the largest of it had been exposed to direct damage, looting and sabotage in an incredible manner as it included stations that separate the gas , pressure stations, stations for pumping oil, production facilities, installations of water pumping and its injection, the tanker storage, vehicles, cranes and drilling equipment, laboratories field, office equipment, generators, stores, workshops, gasoline filling stations and liquefied petroleum gas, offices and camp Fields"

From the above we can note that the post-occupation period, particularly 2003 - 2007 did not experience any geographical exploration of oil, because Iraq lived in a conflict, especially after the collapse of its institutions after 2003.

The situation may have changed after 2007, especially after the relative calm in the security situation, beyond the stage of internal conflict between the political components of the ruling class in Iraq, and the adoption of the government to the support foreign investment, particularly in the oil sector, so 2007-2011 saw large deals with companies from Korea, China, the U.S., France and Britain that are known. These companies had undertaken the exploration and drilling in new areas in Iraq.

Because of the importance of exploratory activity and its central role in the identification of hydrocarbon wealth in the country and to provide alternatives to the production of new fields, the oil ministry developed a new plan for the development of this activity in the following trends

- 1- Increase the capacity of seismic surveys by re-run and to raise the efficiency of the national seismic teams, the development of processing capabilities and interpretations and storage and retrieval of information with modern facilities.
- 2- Discovery of new reserves to boost the total oil reserves for Iraq, through the intensification of drilling exploration and evaluation in the areas of probability as a first step to convert part of the likely reserves into fixed reserves, through the implementation of an extensive program of

exploration work (seismic and geophysical) in the whole of Iraq to add new reserves of oil and gas.

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(\*) The collision of continent blocks that when surging, according to the theory of relegating the continents, led to the formation of a super continent called (Pangaea) . The meaning of this word is 'all the earth'. The break up of this great continent into smaller continents happened before 200 million years ago, and to the east of this great continent there was a sea called Taths, which is located between the arms of bungee north-eastern and south-east, especially after the refraction of the bungee continent and its division into two continents separated by Tethys sea, Lorashea a continent located in the North of Tethys Sea, and the other continent to the south of this sea , is named Gondwanaland . After several defeats and bursts in the Earth's crust , the Tethys sea disappeared and its water retreated in specific parts. Scientists of Geological history refer to the remains of this sea as the Caspian Sea . look : Saad Z. Jassim and Jeremy C. Goff, Geology of Iraq, published by dolin, prague and Moravian museum, brno, 2006, p.27. Also: Salah Hamid al-Janabi and Saadi Ali Ghalib, Iraq's territorial geography ,Mosul University press ,1992 , p32 .

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