Desert, delta and gulf

Oil and gas have played a role in the history of Egypt for thousands of years. Ancient tombs and funeral rites have given way to a modern, dynamic industry that is pushing back the frontiers of exploration and production technology.

Egypt has played a key, pioneering role in the development of Middle East gas resources. In addition to its gas expertise and its role as an oil exporter, Egypt has strategic importance because of its operation of the Suez Canal and Sumed (Suez–Mediterranean) Pipeline, two routes for distribution of Gulf oil.

In ancient Egypt, bitumen was used for mummification. Diodorus, a well-known historian in the time of Julius Caesar, traveled to Egypt in the first century BC. He describes the export of bitumen to Egypt by the inhabitants of the surrounding lands, who gathered bitumen found floating on the Dead Sea. This bitumen was known as *lacus asphaltites*, or bitumen of Judea. In the hands of the embalmers, Diodorus observed, it was mixed with aromatic spices, and that without it, "..the body cannot be preserved long from putrefaction".

Ancient Egyptian shipbuilding, both large and small, benefited from the waterproofing properties of bitumen. Red Sea coracles, or gufa, were made watertight with pitch (these boats can still be seen on the Tigris). According to Greek historians, the Egyptians almost certainly used bitumen to caulk large seafaring ships, sealing the spaces between the planks with bitumen and papyrus. This technique was being used almost 3000 years ago.

The seepages at Gebel Zeit, (Arabic for oil mountain) were known and exploited by the Romans, who named the area Mons Petroliferus. The sticky pools of bitumen were used for domestic lighting and heating, and in quarrying and digging for gold.

Little subsequent interest was shown in oil seepages from the ground until the mining of sulfur began in the late nineteenth century. The discovery of oil by those sulfur miners launched an industry, and a new age.

The dawn of an industry

While mining for sulfur under the Gemsa hills during the 1860s, the French company Société Soufriere des Mines de Jemsah et de Ranga sunk a 80-ft shaft from a 130-ft gallery. The shaft, being below sea level, filled with sea water and a layer of oil. A second gallery filled with the same mixture.

The company approached the Egyptian Government for permission to explore for oil. No doubt appreciating the potential of this find, the Government refused on the grounds that the 30-year concession, granted in 1863, was concerned only with sulfur mining. The Société took the argument to court in 1869. It took the Government 14 years to win the lawsuit.

In 1883, a Belgian specialist, M. de Bay was engaged by the Egyptian Government to explore for oil at Ras Gemsa. Operations began in November 1885, the teams drilling with a steam-driven rig. His moderate success with de Bay Well Number One – which yielded gas and oil at a rate of 1.3 tons per day – was not repeated with wells two and three. In the year of their completion, 1886, de Bay's contract was not renewed.

To replace de Bay, the Egyptian Government looked further west and appointed an American, H. Tweddle, and a team of drillers to continue the search. All five of Tweddle's Gemsa wells were considerably deeper than those of his predecessor's, and all struck or showed oil.

Also in 1886, American geologist and engineer L. H. Mitchell was appointed to carry out a survey of the area. Mitchell's report and recommendations to drill deeper for oil-bearing sediments are now considered to be prophetic, considering that the science of petroleum geology was in its infancy. He also downgraded Giftun, Shadwan, Jubal and other islands, as being at "too great a depth" to contain oil.

Mitchell recommended that drilling should continue at Gemsa, and also at Ras Dhib to the north and Abu Durba on the eastern side of the Gulf. However, after an expenditure of £100,000 the government withdrew support and drilling stopped in July 1888.

Gemsa oil at last

The dawn of the twentieth century saw little or no prospecting in Egypt. In June, 1907, the Egyptian Oil Trust Ltd was registered by Messrs Light and Fulton, in London. Its objectives were to acquire oil concessions, explore, develop, drill, refine, store, supply, distribute and deal in petroleum and petroleum products. It had a capital of £100,000, in £1 shares. Its concessions embraced 100 square miles of territory, immediately west of the Red Sea, and included waters of the Suez Canal, including Gemsa.

The Trust's workers began drilling on January 1, 1908 and a well was completed in March 1909 at a depth of 1920 ft.

The *Petroleum Review* reported on April 24, 1909: "A most important oil strike has recently been made by the Egyptian Oil Trust Ltd, in one of its wells upon the coast of the Red Sea" (Figure 3.1).

Other wells were also to prove fruitful. Later that year, the second ordinary


IMPORTANT STRIKE OF OIL IN EGYPT

Figure 3.1: Two barrels of oil per minute. In 1909 the Egyptian Oil Trust Ltd discovered a Gemsa gusher on the Red Sea coast

meeting of the Egyptian Oil Trust Ltd in London, was to hear that Well Number One had struck large quantities of oil at a depth of 1287 ft, in porous dolomitic limestone. The well was a gusher, producing two barrels per minute.

In the spring of 1912, the first tank steamer left for the Far East with 3000 tons of Gemsa oil on board.

In all, 23 wells were drilled at Gemsa, and for a number of years it was the only source of Egyptian production. But its output gradually declined until, in 1927, it became inoperative.

Hopeful at Hurghada

The Hurghada field lies about 100 miles south of where the Gulf of Suez meets the Red Sea. In 1911, Max K. Bauermann, a geologist who had worked for Shell in Romania since 1909, was sent to Egypt on a short exploratory assignment. He discovered the West Hurghada structure – Cretaceous and Carboniferous (Nubian) sand formations below the Miocene and recommended drilling. The first well encountered oil at 631 ft. In the same year, an examination of the Hurghada region was made on behalf of the Egyptian Government. Drs J. Wanner and H. M. E. Schürmann examined the same area for Anglo-Egyptian oil and, on the basis of their report, an exploratory well was drilled. Egypt's first commercial oil field had been tapped, in Nubian sandstone at about 2300 ft.

Oil exploration stopped shortly afterwards because of World War I, and did not start again until hostilities ended.

Egypt became a major war base during the years 1914–1919, with its population and economy committed to the war effort.

Despite the war, the Hurghada field became what the short-lived Gemsa field could never be – a settled, productive community. Secure employment for 1200 Egyptian people had been created by the industry. Hurghada's peak production came in 1931 when the annual output totalled 1,800,000 bbl.

The twenties: a long, lean decade

The 1920s were lean years for the oil industry in Egypt, and were to be littered with disappointments. By 1923, the Eastern Petroleum Finance Company and Oilfields of Egypt had both drilled wells – some of which reached 3000 ft – on the coast and on the Egyptian islands, and had abandoned operations. Anglo-Persian Oil Company took licenses for large areas of Sinai, drilled, and had similarly given up by 1923. Other attempts to extract oil from the Sinai coasts and islands were also fruitless.

New technology began to be exploited during this otherwise barren decade. In 1923, Anglo-Egyptian Oilfields Ltd introduced the Eötvös torsion balance into Egypt, and Gemsa and Hurghada were surveyed. This was the first time the technique had been used outside Europe, and came before its first use in the USA.

A second rush for black gold

Early in 1937, the Egyptian Government responded to growing pressure to find fresh oil reserves with a massive redefinition of mining regulations. Under the new rules, provision was made for the granting of prospecting licenses over area of not less than four square kilometers, for one year, subject to renewal. The effect was immediate and startling. Companies in the UK and the USA scrambled to apply for licenses, and within a year some were drilling. The five international groups holding the majority of permits were: Anglo-Iranian Oil, Royal Dutch/Shell Group (which included Anglo-Egyptian Oilfields), Socony-Vacuum Oil Co. Inc., Standard Oil Co. of California, and Standard Oil Co. of New Jersey. However, because only 40 permits could be granted to any one company, the Big Five applied for blocks in the names of their subsidiaries. This resulted in no less than 23 companies prospecting by 1939.

By October 20 that year, 8.5% of Egypt's territory was being probed for oil, with extensive geological and gravimetric surveys. In 1938, Anglo-Egyptian Oilfields identified a promising structure, and struck oil in basal Miocene limestone at Ras Gharib, a barren stretch of desert about halfway between Hurghada and Suez. The well was spudded on December 1, 1937, and was completed in April of the following year at a depth of 2560 ft. It produced 150 tons of oil per day (Figure 3.2). Tanks and loading facilities were quickly built, and the first shipment of Ras Gharib crude was made on August 18, 1938. A spectacular rise in production was reported in 1939, with a total output of 5,100,000 bbl exceeding the previous year's yield by 207%.

Seeking solutions in Sinai

Egyptian oil output almost doubled during World War II despite major logistical problems (Figure 3.3). The first post-war exploration success came in 1946 when Anglo-Egyptian Oilfields Ltd, in partnership with Socony-Vacuum Oil Co., struck oil in a wildcat well at Sudr, on the east coast of the Sinai Peninsula. Production from Sudr (around 3.5 million barrels), raised total output for Egypt in 1948 to over 13 million barrels.

Exploration efforts in the Sinai Peninsula (Figures 3.4 and 3.5) intensified after the war. The Standard Company of Egypt (Standard Oil, New Jersey), drilled several wildcats, and a Socony-Vacuum/Anglo-Egyptian partnership drilled at Hamra, northeast of Suez. Exploration began in northeast Sinai, and once mines had been cleared from the Western Desert, test wells were sunk near the Great Pyramids. New tools and technology that had been introduced before the war (Figure 3.6) began to deliver exploration results.

In 1948, a new law was passed by the Egyptian Government. This prohibited exports of crude oil, allowing only the products refined in Egyptian plants to be sold abroad. The request of the Shell Group to expand its Suez refinery to increase throughput was refused, unless the company gave a 51% share in the refinery to the government.

The resulting bottleneck of crude oil inside Egypt, together with the low morale of the European and American companies, effectively curbed exploration until 1953, when a new, more liberal oil law was enacted. In the wake of increasing exploration activity, a new field was discovered at Belayim, about eight miles south of Feiran, by the Southern California Petroleum Corporation, on behalf of the government's International Egyptian Oil Company. Standard Oil of Egypt had carried out reflection seismic surveys during the late 1940s, and Compagnie Orientale des Pétroles d'Egypte (COPE) followed up with detailed land and marine reflection seismic surveys. The discovery well yielded 1150 B/D. Development of the Belayim field passed to the National Petroleum Company (American) in 1956.

The General Petroleum Authority (GPA) was created by the Egyptian Government in 1956. GPA founded the General Petroleum Company (GPC) in 1956 and awarded it 63 prospecting licenses in the Gulf of Suez and the Eastern Desert. Old wells yielded new


RAS GHARIB DISCOVERY Brings Rush
Prospecting Activity to Egypt

Figure 3.2: The World Petroleum report of the Ras Gharib 'oil rush', 1939

oil finds for the company: at Ras Bakr, from Eocene and Cretaceous beds, and at Khreim, eight miles south of Ras Gharib, from Eocene and basal Miocene beds. Between them, the new fields were to contain over 90 wells by the end of the 1960s.

More recent challenges

Field completions in 1967 comprised 30 oil wells, 1 gas well and 2 dry wells, representing an increase of 200% on previous years. The most active operator was Gulf of Suez Petroleum Company (GUPCO), which drilled 12 oil wells and 1 dry well in the Morgan field.

The outbreak of war in June 1967 resulted in loss of the Sinai coast of the Gulf of Suez to Israel. Despite the losses and uncertainties brought about by the war, production increased by 57.5% on the previous year.

October field, the third largest oil field in Egypt (after El Morgan and Belayim fields) was discovered in 1977. The northernmost of the giant oil fields in the Gulf of Suez, it is penetrated by wells from eight separate platforms. The October field comprises at least six reservoirs in four different stratigraphic horizons. Cumulative production from the October reservoirs, since discovery in 1977 until January 1991, exceeded 420 million barrels of oil. Benefits continue to emerge from this huge discovery.

Overall, Egypt produced approximately 5 billion barrels of oil between 1911 and 1991. Daily production increased has dramatically since 1975 but now appears to be stabilizing.

Egypt's share of world oil production has also been stable in recent years. However, despite a long and extensive exploration history, there remains considerable scope for new discoveries. Future exploration, in regions such as the Western Desert and North Sinai, will almost certainly identify major new oil and gas reserves and may lead to a significant rise in oil output.

Present and future

Today, Egypt is a significant oil producer and a rapidly growing gas producer. The Suez Canal and Sumed Pipeline are strategic routes for Gulf oil shipments, making Egypt a focal point in world energy markets.

The Egyptian economy made remarkable progress in the 1990s. Oil exports accounted for about 40% of the country's total export revenues. The government was successful in curbing domestic demand for petroleum products by reducing subsidies and encouraging consumption of natural gas. New natural gas finds, especially in the Nile Delta region, will soon give Egypt enough production capacity to become a significant gas exporter.

Egyptian oil production comes from four main areas: the Gulf of Suez (over 70%), the Western Desert (about 16%), the Eastern Desert, and the Sinai Peninsula. Egypt's proven crude oil reserves are estimated at 3.5 billion barrels.

Oil from the Gulf of Suez basin is produced mainly by GUPCO, a joint venture between BP and EGPC. Production in the GUPCO fields, with most wells in operation since the 1960s and 1970s, is falling rapidly, although it remains substantial at around 360,000 B/D. GUPCO is attempting to slow the natural decline in its fields through significant investments in enhanced oil production as well as increased exploration. BP has announced that it intends to invest $450 million in technology over the next six years to prolong the life of the Gulf of Suez fields.

Besides GUPCO, other major companies in the Egyptian oil industry include Badr el-Din Petroleum Company (EGPC and Shell); Suez Oil Company (EGPC and Deminex); and El Zaafarana Oil Company (EGPC and BG).

Egypt's total oil production has declined more slowly than GUPCO's due to new output from independent producers like Apache and Seagull Energy at smaller fields, especially in the Western Desert. Production in the Qarun block passed 40,000 B/D in mid-1997, up from 5,000 B/D in late 1995.

In October 1997, Apache and Seagull announced an oil discovery in the East Beni Suef concession (which they share 50/50), also located in the Western Desert. The field is said to contain around 100 million barrels of crude oil.

The industry has come a long way since the momentous discovery at Gemsa (Figure 3.7). Egypt produced an average of 866,000 B/D of crude oil during 1998 (Figure 3.8), a slight decline from a high point of 922,000 B/D in 1996. With domestic oil demand increasing due to economic growth, there are fears that the country could become a net oil importer by 2005–2010. Egypt is hoping that exploration activity, particularly in new areas, will discover sufficient oil in coming years to maintain crude oil production comfortably above the 800,000 B/D level.

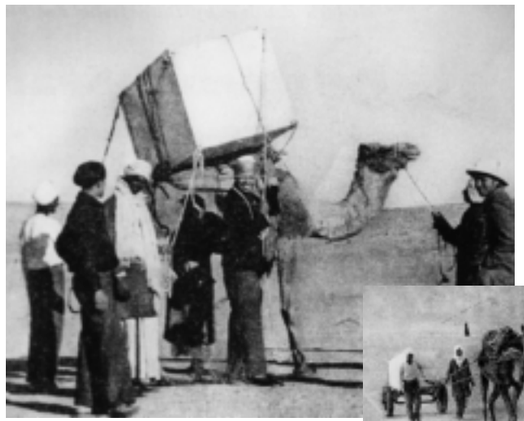


Figure 3.3: In the 1930s and 1940s automotive power often gave way to muscle power. This torsion balance could not be moved by car – only a camel could cope with the terrain

Overall, Egypt now gets about 16% of its oil and 30% of its natural gas from the Western Desert. Oil Minister Hamdy el-Banby said in October 1998, that "Egypt's oil production capacity will increase by 40,000 B/D when new fields in the Qattara depression and the North Coast's El Alamein come online in the next few years." Three recent discoveries in the Western Desert include one find south of Dab'a (93-miles southwest of Alexandria); another at the Qaroun concession (43-miles southwest of Cairo); and a third at the Meliha concession area (50-miles southeast of Mersa Matrouh City).

Spain's Repsol has expanded its oil output in Egypt's Western Desert to 60,000 B/D (from 32,000 B/D in early 1997). A joint venture of Repsol (50%), with Apache (40%) and Australia's Novus (10%) operates the Khalda concession, currently producing 35,300 B/D of oil. In September 1998, the partners announced that they would double their investment to $100 million at Khalda over the next two years in order to increase oil production to 40,000 B/D by the end of 2000.

Offshore production possibilities in the Mediterranean are beginning to be explored. The largest concession awarded from the bidding round in February 1999 went to Shell, for a large, deepwater area off Egypt's Mediterranean coast. BP and Elf Aquitaine were also awarded a large, offshore block. A smaller, offshore concession was awarded to Italy's ENI-Agip.

The 1999 bidding round offered 15 concessions, with only one round scheduled for the year. Among the areas offered were the Mesaha trough in Upper Egypt, which is considered geologically similar to areas in northern Sudan where oil discoveries have been made. Blocks near the Kharga oasis and offshore from Marsa Matruh were also on offer.

A role in distribution

In addition to its role as an oil exporter, Egypt has strategic importance because of its operation of the Suez Canal and Sumed Pipeline, two routes for export of Gulf oil. Tanker traffic and revenues have declined in recent years as a result of competition from oil pipelines and the alternate route around the Cape of Good Hope in South Africa.

Figure 3.4: Oil concessions in northern Egypt in 1938. Note the early exploration efforts on the Sinai Peninsula

The Sumed Pipeline is an alternative to the Suez Canal for transporting oil from the Gulf region to the Mediterranean. The 200-mile pipeline runs from Ain Sukhna on the Gulf of Suez to Sidi Kerir on the Mediterranean. The Sumed's original capacity was 1.6 million B/D, but with completion of the Dashour pumping station located to the south of Cairo, capacity has increased to 3.5 million B/D. The pipeline is owned by the Arab Petroleum Pipeline Company (APP); a joint venture between Egypt (50%), Saudi Arabia (15%), Kuwait (15%), the UAE (15%), and Qatar (5%). APP also has been increasing storage capacity at the Ain Sukhna and Sidi Kerir terminals. An extension of the pipeline is being studied. This extension would traverse the Red Sea from Ain Sukhna to the closest point on the Saudi coast near Sharm al Sheikh, and then continue to link up with the terminal of Saudi Arabia's main east–west pipeline in Yanbu.

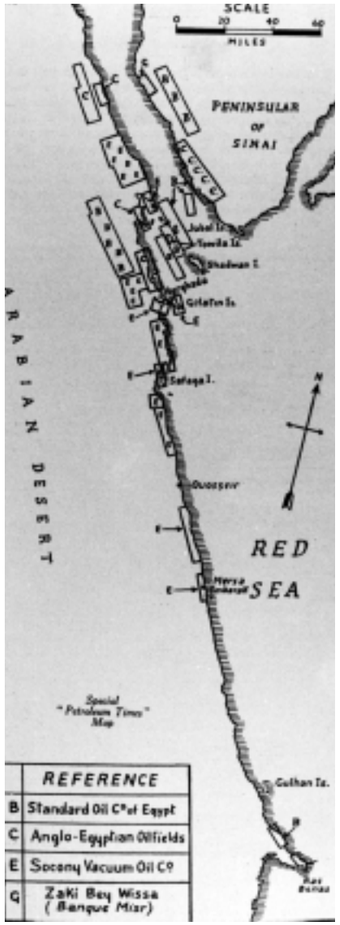


Figure 3.5: A concession map of the southern Gulf of Suez and northern Red Sea in 1938. Note the activity in Sinai

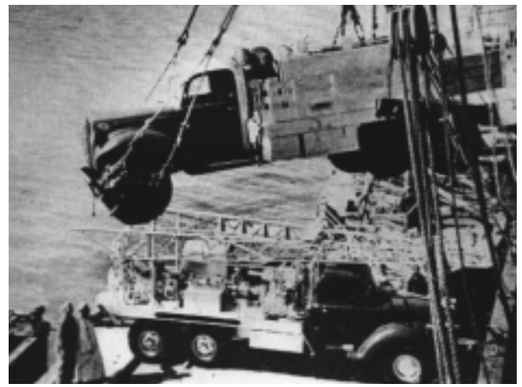


Figure 3.6: South Mediterranean Oilfields Ltd unloading seismic equipment at Suez. Seismic interpretation techniques were in their infancy in 1939

Natural gas in Egypt

Oil companies only began active exploration for natural gas in Egypt in the early 1990s, but they rapidly found a series of significant gas accumulations in the Nile Delta and the Western Desert.

Today, Egypt's natural gas sector is expanding rapidly, with production expected to have doubled by 2001. In recent years, proven natural gas reserves have increased sharply, with a string of major discoveries along the Mediterranean coast/Nile Delta region and in the Western Desert. This trend is likely to continue. In October 1998, for instance, a large, high-quality gas deposit was discovered in BG's West Delta deep marine concession. One of the three wells discovered (Saffron-I) tested at a rate of 90 MMcf/D, which BG says is the highest gas flow rate ever recorded in Egypt. Two other wells (Scarab-I and Scarab-II) tested at 30 MMcf/D each.

Besides BG, other major foreign companies involved in gas exploration and production in Egypt include BP, ENI-Agip, and Shell. Shell has plans to spend around $1.6 billion in Egypt, mainly on gas exploration and development, over the next five years. BP planned to spend $450 million by 2000, while ENI-Agip and BG also plan significant expenditures in this area.

As of early 1999, Egypt's total proven gas reserves were estimated at 31.5 Tcf, up 54% from 20.4 Tcf in 1997, and more than double the 15 Tcf of proven reserves in 1993. Reserves are expected to increase even more over the next few years. Most of this increase has come about as a result of new gas discoveries in the Mediterranean offshore/Nile Delta region, and increasingly in the Western Desert.

In the Nile Delta, which has emerged as a world-class gas basin, recent offshore field developments include Port Fouad, South Temsah, and Wakah. In the Western Desert, the Obeiyed field is an important natural gas area currently under development.

Overall, more than half of Egypt's current natural gas production comes from just two fields; Abu Madi (on stream since the 1970s) and Badreddin (since 1990). Abu Qir is the third largest field, and like Abu Madi field it is considered mature.

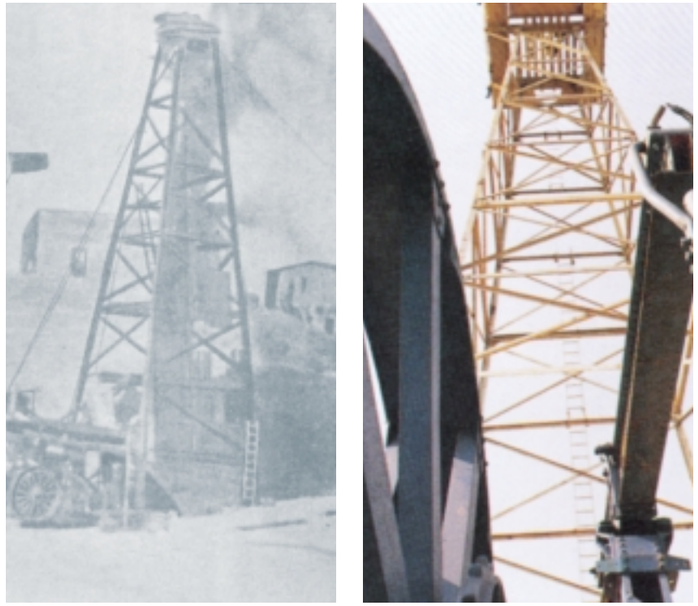


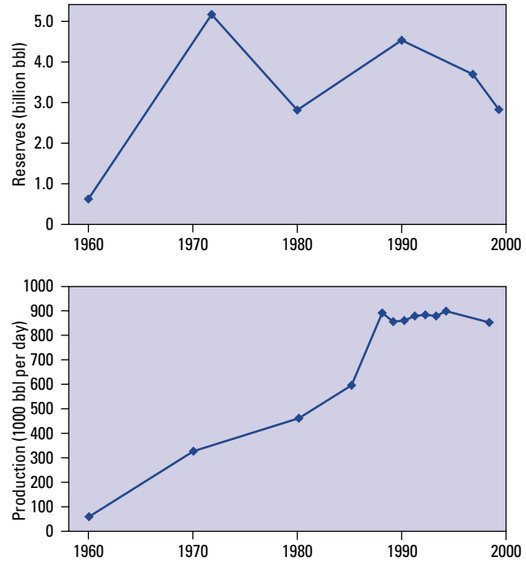
Figure 3.7: Ancient and modern. The Gemsa rig, the first to be used in Egypt, pictured in 1886 (left) shortly after the discovery of oil and in 1986 (far left) when it was a focus for the EGPC conference marking 100 years of modern oil and gas exploration

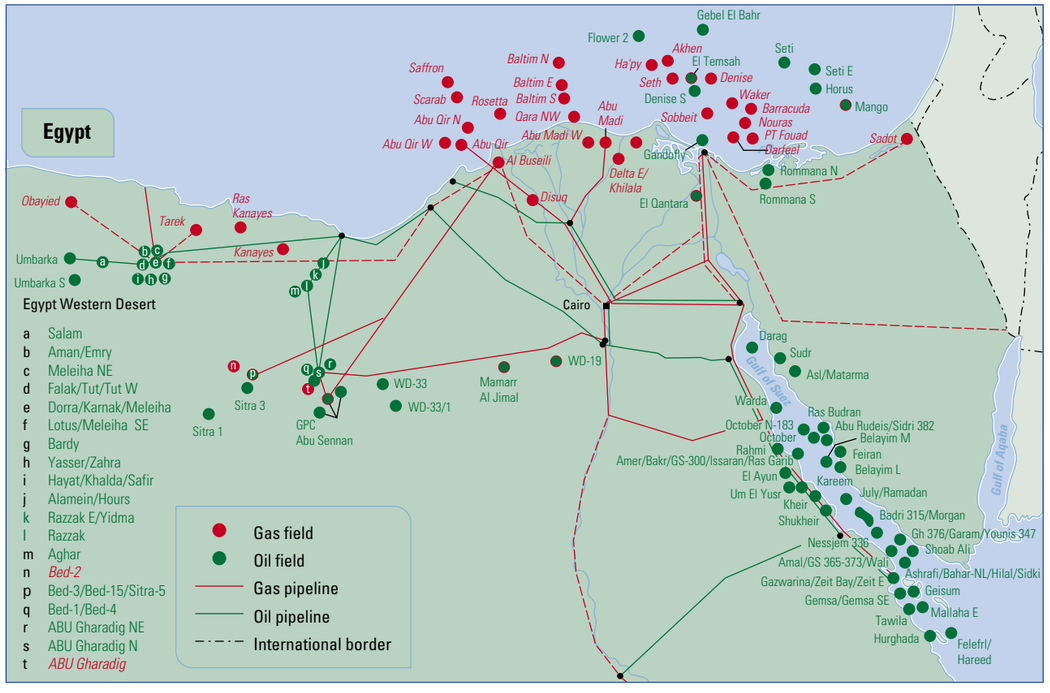
In late 1998, Repsol announced a gas discovery in the Khalda offset concession, adjacent to Khalda. Output from Obeiyed and Khalda will be transported to Alexandria by a 180-mile pipeline. BP and the IEOC are also preparing to bring several fields off the Nile Delta coast into production. These include the Baltim and Baltim South fields, which were expected to come online by 2000, and fields on the Temsah and Ras el-Barr concessions, which are expected online by 2003.

Other companies with recent gas finds in Egypt include Petrobel (the Sigan-1 field), Agip/EGPC (Wakkar), and the UK-based BG Group (Rosetta-5 and Rosetta-6). These three finds are all in the Nile Delta region. Gas deliveries from the Rosetta concession were expected to begin in 2000. Meanwhile, BP has found significant gas reserves in its North Sinai concession. Apache expected its natural gas output in Egypt to grow five-fold between 1997 and 2000, reaching nearly 15 Bcf per year. In April 1999, German RWG-DEA hit gas in its concession in the western Nile Delta, with a flow rate of 30 MMcf/D. In May 1999, the Italian firm Edison and British Gas International made a large find, testing at 45 MMcf/D, in the West Delta deep marine concession. Geologists believe the same type of formations that have been found to hold gas in the Nile Delta also extend out into the Mediterranean.

The rapid increase in Egypt's natural gas reserves and production in recent years has encouraged ambitious plans for gas exports (either by pipeline or liquefied natural gas tanker) to such countries as Turkey, Israel, Jordan, Libya, and the Palestinian territories. Currently, Egypt consumes all the gas it produces. Plans for exporting Egyptian gas have been complicated by pricing issues – Egypt has insisted that it sells gas at fuel–oil parity. Potential customers such as Israel have considered that too high, as prices would need to be low enough to offset the investment required for the necessary infrastructure.

Figure 3.8: The rising trend in Egypt's oil production stabilized in the mid-1990s and stood at 866,000 B/D in 1998





The oil and gas fields of Egypt