Photo: DNO

Targeting Giants in Kurdistan

Most of the Kurdistan region is part of the foothills of the Zagros with an undulating landscape and a few sporadic mountaintops. Geologically, Iraq can be divided into five main geological provinces: a) the stable Arabian platform, b) the Mesopotamian Foreland Basin, c) the Zagros Low Folded Zone, d) the Zagros High Folded Zone, and e) the Zagros thrust Zone. The Oil discoveries are mostly in the Zagros Low Folded Zone and the Mesopotamian Basin. DNO is carrying out their operations in the Zagros Low Folded Zone northwest of Kirkuk and close to the border with Syria and Turkey. Some of the larger fields have been highlighted (green: oil; red: gas).

Great Wall Drilling Company (GWDC) rig #9 mobilized from China and commenced drilling operation on the well Tawke #1, the first well to be drilled by DNO in Kurdistan. This is a new rig fitted with a top-drive drilling system and capable of drilling to 5,000 meters depth. GWDC is also providing most of the well services for DNO, including mud-logging, electric logging, cementing, coring and testing. In December of 2004 DNO established a local office and an organization in the city of Erbil situated a few hours drive from the Tawke #1 well. An expatriate management team for the Kurdistan operations has been established in Dubai, which today can be reached with a non-stop flight from Erbil. Dubai has got the infrastructure and service providers to serve the entire Middle East region including Iraq.

Oil is flowing to the surface in several seeps within the license area, and nearby giant fields have been producing for decades. The well Tawke # 1 is certainly being drilled in a proven petroleum province, and the first well by a foreign company in Kurdistan is now testing a huge structure delineated by modern seismic data.

Halfdan Carstens

Late November the Tawke #1 well was spudded in the prolific Zagros Fold Belt of northern Iraq with DNO ASA (DNO) as the operator. It is estimated to take 60 days to drill the well that is targeting three different reservoir zones in the Tertiary and the Cretaceous, down to a depth of 3,000 meters.

"The structure is huge and has great potential for significant commercial discoveries," says Magne Normann, Project Director for DNO in Iraq. He adds that the first well will have to be drilled before oil quantities can be announced, but it is not uncommon that billion barrels fields in Iraq have been placed on production. This first exploration structure to be drilled is relatively close to existing pipeline infrastructure exporting crude oil from Iraq through Turkey to the Mediterranean coast.

Needless to say, not only the operator, but the entire petroleum upstream sector, is excited about this first well being drilled by a foreign company in the autonomous Kurdish region of Iraq, following the collapse of the Iraqi regime in 2003.

Tawke # 1 well, located northeast of the river Tigris, is the first well being drilled under the existing Production Sharing Agreements (PSA) that covers some 4,000 km^2. The small and independent oil company DNO signed the PSA agreements with the Kurdistan Regional Government (KRG) in June 2004. DNO has a 40% interest in the licenses. The initial drilling campaign includes three wells, but DNO is already planning a further four exploration wells in the agreement areas. "Additional appraisal drilling is highly likely, and DNO is already negotiating terms for a second drilling rig to be mobilized to Kurdistan," Normann says.

DNO is already present in the Middle East and is producing approximately 17,000 barrels per day from three fields in Yemen. The company also has an active exploration campaign going on in Yemen (GEO ExPro No. 3, 2004), where prospects with both Cretaceous sandstones and Precambrian crystalline rocks are being tested.

Magne Normann is Project Director for all of DNO's activities in Iraq and has an international background as a petroleum engineer. He has held senior positions for oil companies as well as drilling contractors in several countries including Norway, USA, UK, Singapore and Yemen. In the background we see a satellite map of the area where the operations in Kurdistan is taking place.

Iraqi oil production

"We consider northern Iraq as the most promising geological province in the world for the next 20 years," says Magne Normann. It is easy to agree with him, as almost 200 billion barrels of oil equivalent is already proven in the Zagros Fold Belt (Iran and Iraq combined).

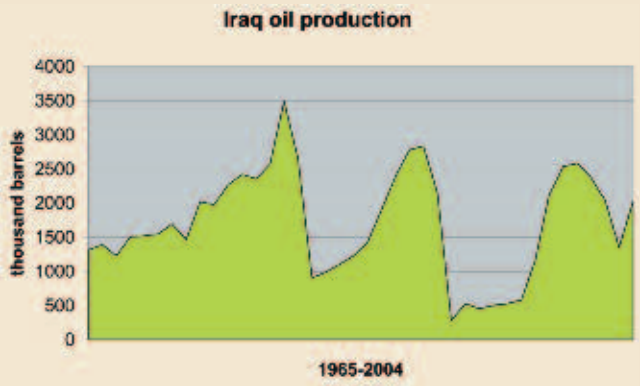
According to the BP Statistical Review of World Energy 2005, the Iraqi oil production averaged 2 million barrels of oil per day in 2004. As can be seen from the graph (page 17), however, the oil production has had a turbulent history the last 25 years.

Since 1969 it was rising continuously, reaching a record level of almost 3.5 million barrels per day in 1979. Major drops in crude oil production accompanied both the 10-year long war with Iran and the 1991 Gulf War. Output dropped from almost 3.5 million barrels per day in 1979 to 900,000 barrels daily in 1981, following the onset of the war with Iran, and from 2.9 million barrels per day in 1989 to 300,000 barrels daily in 1991, following the embargo on Iraqi oil exports. In September 1991, the UN proposed a plan to allow Iraq to raise revenue for humanitarian purchases and war reparations by exporting limited quantities of oil.

For most of the 1990s, the US-imposed trade embargo reduced Iraqi access to oil industry technology, supplies, and investments. Some four years ago it was indicated that of Iraq's 73 oil fields, only 24 were actually in production.

Iraq's target is reportedly 6 million barrels of oil per day. With reservoirs possibly being damaged because of lack of reservoir management attention through several decades, this is going to be a tough case. New discoveries will certainly help to meet the ambitious target.

"We estimate that it will take approximately 18-24 months from project sanction to bring a discovery in northern Iraq into production, if we hit commercial quantities of oil," says Normann.



The Iraq oil production has a complicated story since 1965, reflecting political turmoil. Source: BP Statistical Review of World Energy 2005

Oil seeps everywhere

"The first hydrocarbon exploration license in the area was operated by Iraq Petroleum Company (IPC) who had a large concession area east of the Tigris River (mostly Kurdistan) back in the early 1920's and onwards. Until the IPC exploration concession ceased in 1960/61, there is little documentation indicating that the DNO acreage was properly evaluated at that time. Only field geology in the highly folded zones to the north is documented. Since the early 60's, little or no hydrocarbon exploration has taken place in the area," says Nils Bang, Project Geologist with DNO.

Nils has spent several months for DNO doing the necessary mapping and sampling in order to analyze the outcropping formations that the company will hit while drilling. "It's a beautiful country to do geological fieldwork in," he says.

Some seismic of fair to bad quality had already been acquired in the area before DNO entered the scene, but there was an urgent need for more data to define 4D-closures that made drillable prospects. Altogether, 440 km of 2D seismic were acquired across selected areas of the Dohuk and Erbil PSAs agreement areas; the PSAs are named after the cities with the same name.

"Before the seismic campaign, however, we did a lot of regional geological studies to get a better grip on the prospectivity. Some data was located in Iraq, but most of it was located outside, and it became apparent that we had to search wide to establish a reasonable database. We have also been doing geological mapping within the license area," Bang explains.

"This part of Iraq belongs to the Zagros


Photo: DNO

Mertz 18 vibrators were used to acquire 2D seismic in Kurdistan. They all belong to DNO but were operated by Terra Seis International of Canada.

Iraq – A lake of oil

According to the BP Statistical Review of World Energy 2005, Iraq has oil reserves of 115 billion barrels and gas reserves of 3,17 trillion m3 (135 oil equivalents altogether). Iraq is thus only trailing behind Saudi Arabia and Iran with respect to conventional oil reserves. If we include heavy oil, however, the Canadian oil sands reserves ranks higher than both Iraq and Iran, and possibly also higher than Saudi Arabia (GEO ExPro No. 5/6, 2005).

Estimates of Iraq's potential oil reserves, i.e. undiscovered oil resources, are very speculative, as the country as a whole should be considered underexplored. Another factor adding to the uncertainty is the lack of knowledge about the petroleum systems that stems from the minimal amount of geological studies carried out during the last decades.

"Of all the uncertainties in assessing world oil resources, one of the greatest is the future of Iraq," says Thomas Albrandt who was in charge of the USGS World Petroleum Assessment 2000 (GEO ExPro No. 1, 2004).

Nevertheless, it is widely believed that Iraq may soon prove oil reserves in the order of 200 billion barrels, close to a 100% increase. Iraq will then rank as no. 2 in the world with respect to oil reserves. Others are of the opinion that the Iraqi reserves eventually will be proved to be 300 billion barrels.

"Iraq contains whole petroleum systems: world-class source rocks, overlain by excellent reservoirs and terrific evaporite seals," says Ahlbrandt (Geotimes, 2002). Their assessment of Iraq is, however, not as optimistic as that of many other unofficial sources. The USGS mean estimate for undiscovered resources in Iraq is 45 million barrels of oil and 21 billion barrels of oil equivalents of gas.


Photo: DNO

Kurdistan

The Kurds are an Iranic people inhabiting a mountainous area of Southwest Asia that includes parts of Iraq, Turkey, and Iran as well as smaller sections of Syria, Armenia and Lebanon. Ranging anywhere from 25 to 27 million people, the Kurds comprise one of the largest ethnic groups without their own country in the world.

The Iraqi Kurdistan, also called Southern Kurdistan, is a large area situated in northern and northeastern parts of Iraq, including Erbil (Hewlêr), one of the largest cities in Iraq, and the capitol of the Kurdistan Regional Government. The Kurdish Autonomous Region is a political entity established in 1970 following the agreement of an Autonomy Accord between the government of Iraq and leaders of the Iraqi Kurdish community.

For over a century, many Kurds have campaigned and fought for the right to 'self-determination' in an autonomous homeland known as "Kurdistan". The governments of those countries with sizable Kurdish populations are actively opposed to the possibility of a Kurdish state, believing such a development would require them to give up parts of their own national territories.

The city of Dihok is the centre of the Dihok Governorate.
Kurdistan region cover three governorates and those are Dihok, Erbil, and Sulemania.

Photo: DNO

Fold Belt that strikes southeast-northwest through both Iran and Iraq. Numerous oil fields have been discovered in both countries, and a sizeable discovery was recently announced by Norsk Hydro operating in Iran close to the border with Iraq."

"The DNO PSA agreement area contains a number of structures of different magnitude. Not all of them are, however, considered highly prospective. Some of the structures are uplifted and breached during the Pliocene and Pleistocene folding and uplift," Bang says.

The experienced geologist, who can add several years working in the Zagros Fold Belt for another company on his CV before joining DNO, do like the geological observations he has made. "There are several nice structures with good oil seeps in many places, which is a good reason to be optimistic about this area," he says.

Nils Bang points out that the reservoirs may be problematic, often with very variable matrix porosity and complex fracturing. "One of the biggest challenges is to develop a high reservoir understanding so that the recovery of oil from each structure can be increased from the very low 10-15% which is so common in the area," he says.

Provided that DNO makes a discovery, there appears to be a lot more work in the pipeline for reservoir geologists with experience in carbonate rocks!

Completed in four months

Having made the decision to acquire seismic data with the plan to continue with drilling, the initial task was to establish a secure environment for all personnel involved. "We first hired a risk management company with good understanding and experience from similar activities in Iraq. Considerable efforts were made to have a security plan implemented, which would provide protection and security for all personnel involved in our operations. We worked closely with the Kurdistan Regional Government (KRG) on this issue, and KRG is providing all security guards for the operations. There is no doubt that we have an excellent security team in place," says Normann.


Photo: DNO

One of several oil seepages discovered during geological fieldwork. These tar beds, covering more than 1 km2, are close to the area where the 1st exploration well is being drilled. Jurassic marine shales and carbonates are the major sources of hydrocarbons produced in the Zagros Fold Belt.

"Our first international contractor mobilizing to Kurdistan was Terra Seis Internationa (TSI)l of Canada. At the time of bidding this work, there were many concerns raised by the contractors. Those were ranging from political concerns; i.e. contractors being blacklisted for future work in Iraq, to concerns related to the security of expatriate personnel. It was a must to involve the international contractors as much as possible in preparing and implementing security plans. It initially turned out that very few contractors were interested in this opportunity. This has now changed," says Normann.

"TSI is offering geophysical services to many oil companies operating in challenging geographic, economic and political lands. Their specific focus is to work in tropical, transitional or mountainous terrains."

The seismic acquisition execution model for DNO was somewhat different than normal. TSI brought the core expatriate crew to Kurdistan, predominantly supervisors, whilst the rest of the crew was recruited locally by DNO. Instead of using dynamite source, it was decided to use vibro-source technique. As TSI did not own any vibrators at that time, DNO procured five second hand vibrator units with the assistance of TSI which were tested and upgraded in Canada before being mobilized to Kurdistan via Turkey. "This was hard work for all parties involved. Working outdoors in 50 °C in the middle of the summer is hard for anybody. TSI did a professional job," concludes Normann.

The seismic acquisition survey took four months to complete, starting May 17th and ending September 20th. The data was transferred via the Internet and processed continuously by the company PSS-Geo in Oslo, Norway.

"Interpreting the data was done whilst it was recorded , and prospects were defined from late summer through to October when we had ranked all the prospects we were able to define," says Bang.

Need for training

"The Iraqis have lost one generation of petroleum geoscientists because decades of unrest," says Normann. "This is really sad because Iraq was once a centre of excellence within the petroleum sector in the Middle East. There are still a lot of highly skilled personnel, but they would typically be 60+ years today and there are very few in the country to replace the older generation. Extensive training of the younger generations is an absolute must, and DNO is heavily involved in providing special

Kirkuk – and thereafter

Drilling for oil and gas dates back to the dawn of the 20th century. In 1902 the very first exploration well was spudded in the Zagros Basin in northeast Iraq. However, it took another 20 years before the first small discovery was made in 1923.

Iraq's dramatic entry into the oil era, however, began in 1927 when the first well on the structure Kirkuk – Baba Gurgur # 1 – struck oil under high pressure and suffered a severe blowout. Close to 1 million barrels of oil was wasted before the well was controlled. Kirkuk, named after the town with the same name, has later proved to be a supergiant oil field (for definition, see page 50) with original reserves of 17 billion barrels, approximately one fifth of the original reserves in Ghawar (Saudi Arabia), the world's largest oil field.

Kirkuk is a large, narrow anticline, stretching some 150-200 km, striking northwest-southeast with three domal accumulations and with a 610m oil column. The principal reservoir is a reefal late Eocene to Oligocene (Tertiary) limestone. Oil is also found in younger limestones and older Cretaceous reservoirs. The overlying salt and anhydrite beds have formed a slightly imperfect seal that has allowed oil and gas seeps in localized areas. Certain gas seepages have long been known as "Eternal Fires". The source rock is thought to be Cretaceous dolomites and limestones.

The city of Kirkuk, 370 km north of Baghdad, with close to 1 million inhabitants, is now the centre of the northern Iraqi petroleum industry.

As of today a total of 75 major oil and gas fields have been discovered in Iraq. Nine of them are considered supergiants (including Kirkuk, Rumalia South, Rumalia North, Majnoon) and 22 giants, according to Mohammad Al-Gailani (Geotimes, 2003).


Photo: DNO

Kurdish flag from a nearby village. The Kurdish flag has three horizontal bands with a golden emblem at the center. The sun emblem has a religious and cultural history among the Kurds, stretching into antiquity.


Photo: DNO

The Prime Minister of the Kurdistan Region, HE Nerchirvan Barzani, performing the formal opening of the commencement of the 1st exploration well, Tawke-1, being drilled in Kurdistan, Iraq. Magne Normann has the overall responsibility of all activities related to Iraq.

courses and on-the-job training at Middle East and European training centers.

There is a great need for geologists, geophysicists, reservoir engineers and petroleum engineers to fill in for the older generations," he says and adds further, "It is our duty to support an educational program for the young students that are going to build this country in the years to come. We have signed a Memory of Understanding with the Ministry of Oil in Baghdad which focuses on training as well as providing university education at Master of Science degree level for initially six students".

From high to low risk

Both Iraq and Kurdistan have come a long way since the fall of Saddam Hussein. "We firmly believe that progress will be made towards stability in the country," Normann says.

"While the political risk may have seemed sky-high at the time of signing the Production Sharing Agreements in June 2004 with the Kurdistan Region Government (KRG), this risk has been more or less removed with the introduction of the new Constitution in October 2005, giving the Kurds rights to 'new' oil discoveries within their region," he adds.

"Kurdistan has a unique position under the new Constitution to explore and develop 'new' oil under their own control, and DNO was the first international oil company in more than two decades to perform seismic and drilling in Iraq. The high discovery potential of mega size oil fields makes an interesting future for our stakeholders. Both KRG's and DNO's combined efforts is a move towards an interesting future", concludes Magne Normann, Project Director for DNO in Iraq.

Making a discovery

The first well within DNO's PSA's located in the Kurdish area of Northern Iraq, Tawke # 1, has already encountered movable oil at the top of the first prospective reservoir interval.

Tawke # 1 had by late December reached the first prospective reservoir interval at approximately 350 meters. While drilling into the top of the reservoir section the well took influx of oil under pressure. The oil was circulated out and flared off in a controlled manner. Samples of the oil were taken confirming an API gravity of approximately 24 API. This API grade corresponds to oil produced from other fields at similar reservoir level in Northern Iraq.

The forward plan is to continue drilling the full reservoir section, which could be up to 800 meters thick according to the prognosis. Thereafter wireline logging will be undertaken to evaluate the reservoir with respect to reservoir characteristics and movable oil content, DNO said in a press release.


Photo: DNO

One of several oil seepages in an area close to the 1st well being drilled. The local population has for generations used oil from these oil seepages for domestic needs.