Deep drilling for oil, gas and minerals

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ANGER

seit 1863

Oil and gas – a history

More than 80% of our primary energy requirements are provided by established mining activities. This includes coal (lignite and hard coal), uranium as well as oil and gas.

Even more than 5000 years ago mankind made use of oil, though they still only used oil that came to the surface naturally. Drilling to exploit these energy resources was not an option back then.

Evidence exists that early human advanced civilization, in Mesopotamia at that time, already used asphalt for construction.

The ancient Greeks and the ancient Romans were already able to employ oil as a lubricant and for sealing purposes.

Gas was known about in those early days also, yet still nobody knew how to use it.

Today, 1859 is considered as the beginning of the industrial usage of oil. It was then that Edwin Drake successfully drilled for oil in the state of Pennsylvania for the first time. He used steam engines to drive a simple drilling rig and needed two months to drill 21 m.

According to British chroniclers gas was already used in China in 900 BC. It is said to have been discovered during salt production and that it was first used to hasten the drying of the salt.

However, the findings from China did not make it to Europe before the 17th century.

It is only in 1910 that reports exist of a gas discovery in Germany when drilling for water in the region of Hamburg, the well stroke a gas field.

On-the-job safety and environmental protection

Our company is certified within the framework of the management system SCC (Safety Certificate Contractors) by Germanischer Lloyd. The number-one priority of our company is safety.
One of our key strengths is our highly qualified staff who has many years of experience with our company. Specialisation and competency in our procedures and processes ensures that a high degree of quality is achieved and maintaned in the work routine on a long term basis.

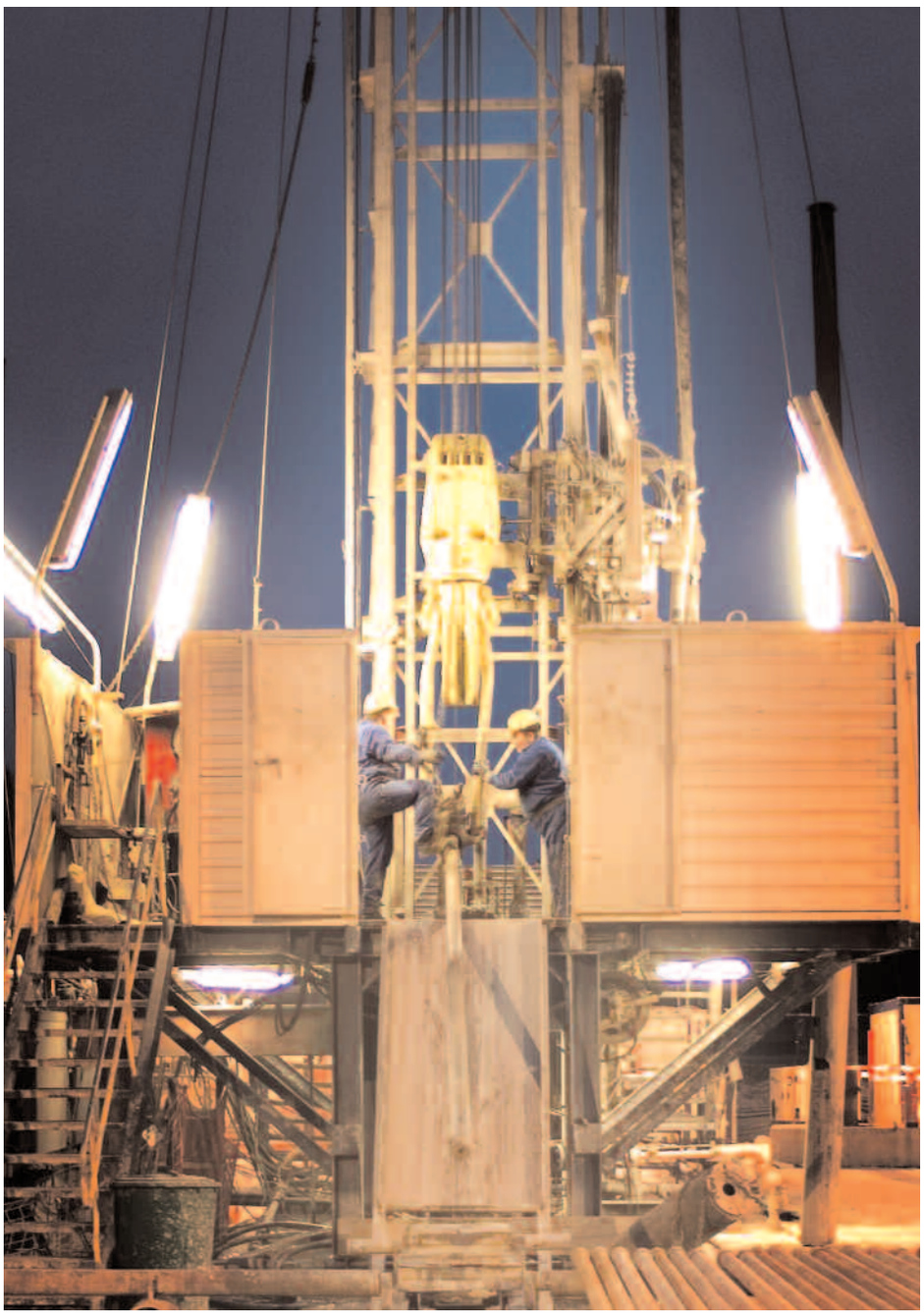
Likewise, the reduction of all emissions proceeding from the drilling operations – like noise, vibrations, odours, light or dust – is of utmost importance to us and preventive measures are taken in order to avoid such emissions. Only certified, environmentally friendly materials (such as chemicals) and equipment are employed.

Noise attenuation, for example, plays an essential role in the deployment of our 410 mton drilling rig Innova Rig in environmentally sensitive areas, which will be subject to closer consideration later on.

The consistent implementation of noise reducing measures during the erection and operation of equipment has enabled us to carry out a variety of projects even in close proximity to housing, without any disturbances of the surrounding neighbourhoods.

As a result, no lawsuits or complaints whatsoever have arisen despite the fact that the work runs 24/7 and with an average duration of three to four months at one site.

The narrative on the following pages concerns the fields of activity most important to us and it will give you a first impression of the procedures we adopt and the project execution.



neues Bild!!
Blick auf die Arbeitsbühne
Mitarbeiter beim Gestänge-
Ein- und Ausbau

Oil and Gas –

The oil and gas that is used today for the generation of energy was created millions of years ago.
At that time, like today, plankton, bacteria and seaweed were living in lakes and seas. Once dead, this plankton sank to the bottom of the respective stretch of water and mixed with sand and clays.

In the course of time many other layers of sediments were deposited upon this organic material.
What we call 'mother or host rock' today developed wherever this process happened so quickly that no oxygen was included and, thus, no natural decomposition was possible. This was the creation of the raw material for the development of oil and gas.
The host rock was pushed further and further down into deeper layers, as more and more sediments were deposited. With growing depths, it was subjected to increasingly higher pressures and temperatures.

Due to the rock's exposure to these high temperatures and pressures over millions of years, complex chemical conversion processes took place which resulted, finally, in the creation of oil and/or gas.

Oil developed at a temperature of 60 °C to 100 °C. Where it was subjected to temperatures higher than 100 °C, its molecular structure decomposed into its constituent elements, mostly methane, as well as ethane, propane and butane.
A large amount of the latest three can be found especially in the gas that has developed from this process.

Likewise it occurs in gas that has developed from a host rock of material that is predominantly animal-organic. This gas is also called 'wet gas'.

Tank system 240 m³

from sea dweller to energy source

A far larger amount of gas, however, develops in host rock of predominantly plant-based organic material, by means of naturally occuring processes of 'cooking' in the course of millions of years.

As a rule, more than 90% of this so called 'dry gas' consist of methane. Apart from the gases mentioned earlier, further components of this gas are generated such as carbon dioxide and nitrogen.

A third way of creation of gas is by decomposition of bacteria. This is the basis for most of the gas which is found and exploited today. In this process, bacteria that had been included into the host rock, directly transforms the organic material into gas. This type of gas is made of no less than 99% methane.

A peculiarity of this type – which might also explain its higher rate of discovery and usage rates – is the fact that this bacterial development did not depend on increasing temperatures created by the deposition of layers of sediments to form the host rock.

In contrast to the so called thermo-catalytic process described above, which required depths of up to 4000 m, gas of bacterial development could be created at far shallower depths.

Iron roughneck

Formation and structure of reservoirs

When looking at oil and gas deposits that developed in deep layers, it stands out that they are produced from different geological stratum today from the one where their original host rock is situated.

Thus, the so called producing horizon no longer corresponds to the place of origin of the energy source – the layers where they can be found today are also called carrier rock or reservoir rock. This indicates that oil and gas must have changed their position in the course of centuries.

All this becomes fairly plausible when one considers the fact that oil and gas possess lower densities than other materials. Due to this difference in density hydrocarbons always strive to take up the highest position in a host rock.

Consequently, after their creation, oil and gas moved upwards through fissures in the rock. When they reached the surface, gas and light components of oil escaped into the atmosphere. Residues remained on the ground and created, for example, oil sand and tar sand.

However, if the hydrocarbons were stopped on their way by an impermeable geological stratum, they accumulated under this barrier or seal.

That is, they were deposited in the tiny pores of the rock, without being able to escape. These layers are then called reservoir rock.

The different densities also determine the structure of such a reservoir: the gas is always on top of everything else, followed by a layer of oil and, ultimately, water.

aus einer BP-Broschüre!!

Ways of exploration

Today, like in former times, drilling for oil and gas deposits is still a very cost-intensive process. In the past it was not quite unusual to hire a diviner to locate the position of a potential field.

Nowadays much more scientific methods exist to discover – in advance and with utmost precision – the existence and yield of a reservoir. Thus indirect geophysical and chemical methods as well as satellite imagery are possible today. These methods can give hints as to the existence of suitable structures.

Likewise, it it possible nowadays to carry out gravimetric and magnetic surveys from an aircraft. Gravimetric tests use the different densities of rock and can give indications about the structure of the underground by analysing changes in the force of gravitation.

Thus, for example, salts stand out sharply from other surrounding rock due to their lower density. Not forgetting that salt domes, as the story from China has already shown, are very good indicators for the existence of oil and gas supplies, since their reservoir rock has often been displaced by salt that bulged up. Many times oil and gas accumulates at the edge of those salt domes.

The magnetic surveys mentioned above give some indication of the boundaries of rock very deep in the underground, where the magnetism varies.

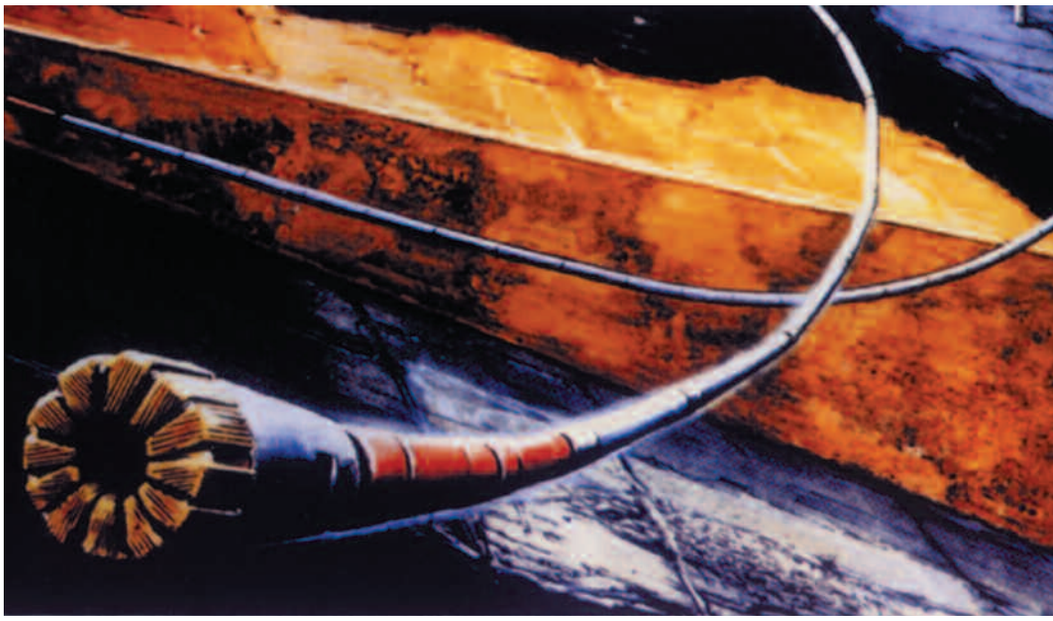
In case all these methods prove the area to be a promising production district, the technology of 3D-seismic reflection surveying is able to give further certainty. This technology uses the reflection of sound waves. Various types of rock reflect these waves in different ways.

With the help of the results computers are able to create a three-dimensional image of the underground. Ideally, this image makes possible a prognosis about the rock permeability and whether oil, gas or water can be found in its pores.

In cases where the results of geophysical surveying turn out to be positive and indicate the possible presence of oil and/or gas, decisions can be made about drilling an exploration well.

At the end of the day, only exploration wells can give certainty about whether or not hydrocarbons exist and the reserves be estimated.

For despite all modern technical indirect exploration methods available, success rates of such projects are only up to 33% even today.



source: Weatherford Energy Services GmbH

Different drilling methods exist to carry out such exploration wells. Two of the most common ones are rotary drilling and drilling by using downhole motors or turbines.

Innova Rig

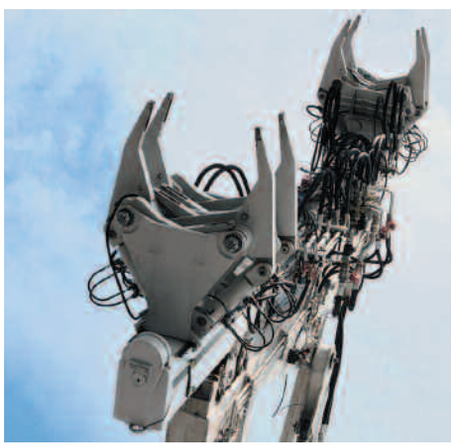
For the tasks described above, H. Anger's Söhne offers you a variety of possible solutions. Below you will find details about our largest and most powerful drilling rig, the Innova Rig.

The Innova Rig has been designed by our company in co-operation with Herrenknecht Vertical and the German Research Centre for Geosciences (GFZ) Potsdam, in order to meet all current and future drilling requirements – on both a scientific as well as an industrial level. Its most noticeable advantage lies in the reduction of the required manpower and the consequential reduction in operating costs.

Basic data:

- the hook load of Innova Rig is 4100 kN
- mast and hoist system consist of a hydraulic double cylinder system
- suitability for drilling up to depths of up to 6000 m
- the rig is automated for most operations which improve safety by eliminating tasks that would normally be carried out manually. These operations are substituted by handsoff-technology. Thus, strenuous work on the drilling platform is reduced to a minimum.
- Four drilling techniques are available with the rig: rotary drilling, conventional coring, wireline coring and under-balanced air-lift drilling.
- mud system, pumps and tanks are modularly adjustable to the four drilling techniques mentioned above.

What makes Innova Rig so innovative is, above all, the possibility to switch quickly between the different drilling methods, like rotary drilling or wire-line coring.



The rig's high level of automation allows for great adaptability and therefore ensures compliance with the highest safety standards.

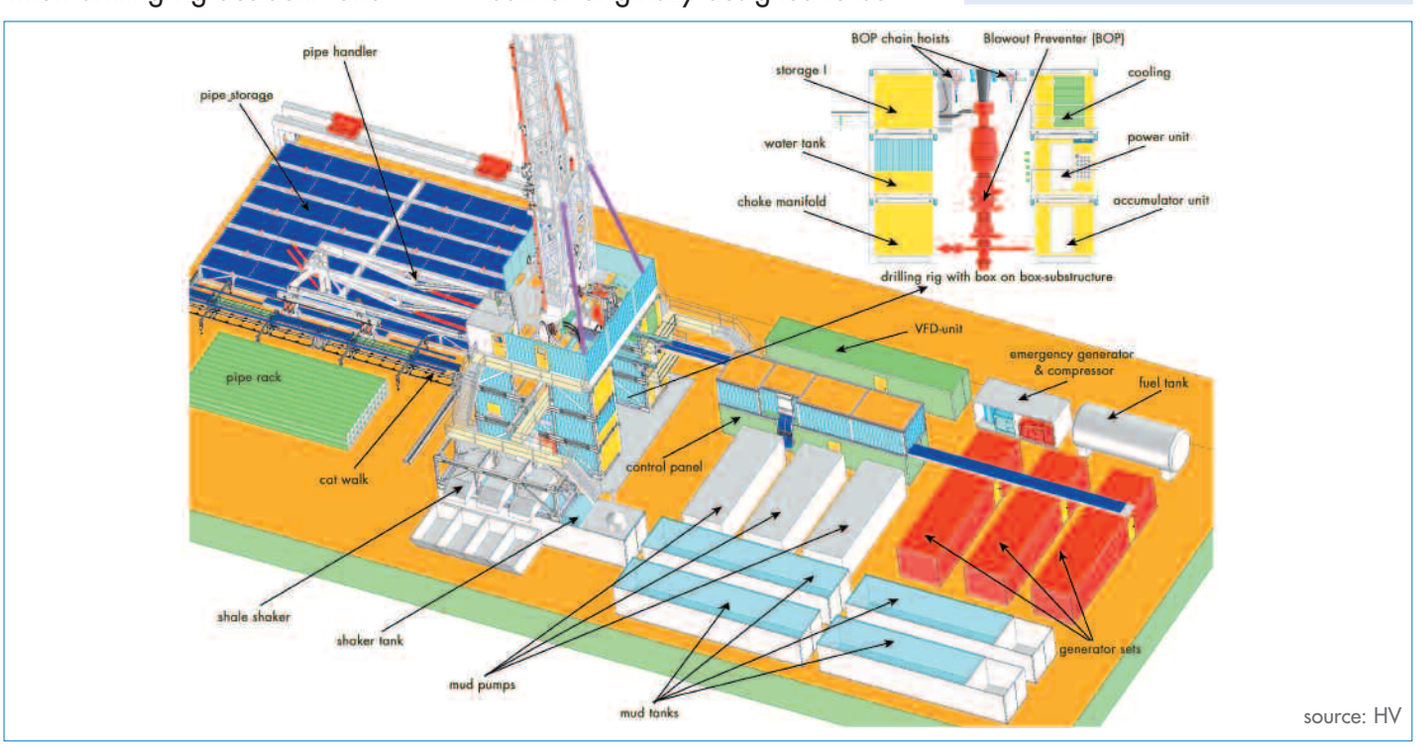
Consequently, H. Anger's Söhne has been working with this 410 mton drilling rig accident- and incident-free since bringing it into service in 2007.

What should also be stressed here is the advantage that the Innova Rig ensures minimal environmental disturbance. For example, the space needed for the rig location is much smaller than the one necessary for conventional drilling rigs. Furthermore, during the design phase, all machines and equipment parts were examined with regard to their possible production of noise. In this process, all necessary measures for the reduction of noise were taken.

The elimination of the so called 'racking board' results in considerably less noise at high altitudes during tripping. Therefore, this enables us to drill in an inner-city area, even in close proximity to housing. For the project 'GeneSys' in Hannover, for example, a noise barrier originally designed to be 15 m high, could be reduced to 10 m. Measurements revealed that the plant was working below 50 decibels during the entire drilling time.

Technical data and additional details:

- nominal rotary speed 220 rpm
- rotary torque 40-75 kNm
- wireline coring speed 500 rpm
- wireline coring torque 12-18 kNm
- tripping speed Ø 500 m/hr
- hoist cylinder stroke 22 m
- drive power up to 4000 kW
- rig weight approximately 3700 kN
- mud pumps 3 x 1000 kW
- 350 kW wireline coring mud pump
- mud pressure max. 350 bar
- mud tank system 240 m^3
- generator set 3 x 1540 kVA
- wireline coring winch with 5000 m of 12.7 mm diameter wireline



source: HV

Security of supply

Security of supply by storages

Once produced, a way is needed to store gas in order to meet today's demands from modern energy sources and to guarantee long-term security of supply.

Such gas storage facilities are designed to store any surplus of gas so that it is available to utility companies and, thus, consumers in times of increased demand. In this way, reliable supply can be guaranteed.

Different types of storage can be distinguished. On the one hand, there are gas tanks which are surface storage facilities that are intended, above all, to balance short-term interruptions in the gas supply. There is also the possibility to use so called high-pressure storages. In this case, gas is stored in pipes that have been laid out in the underground.

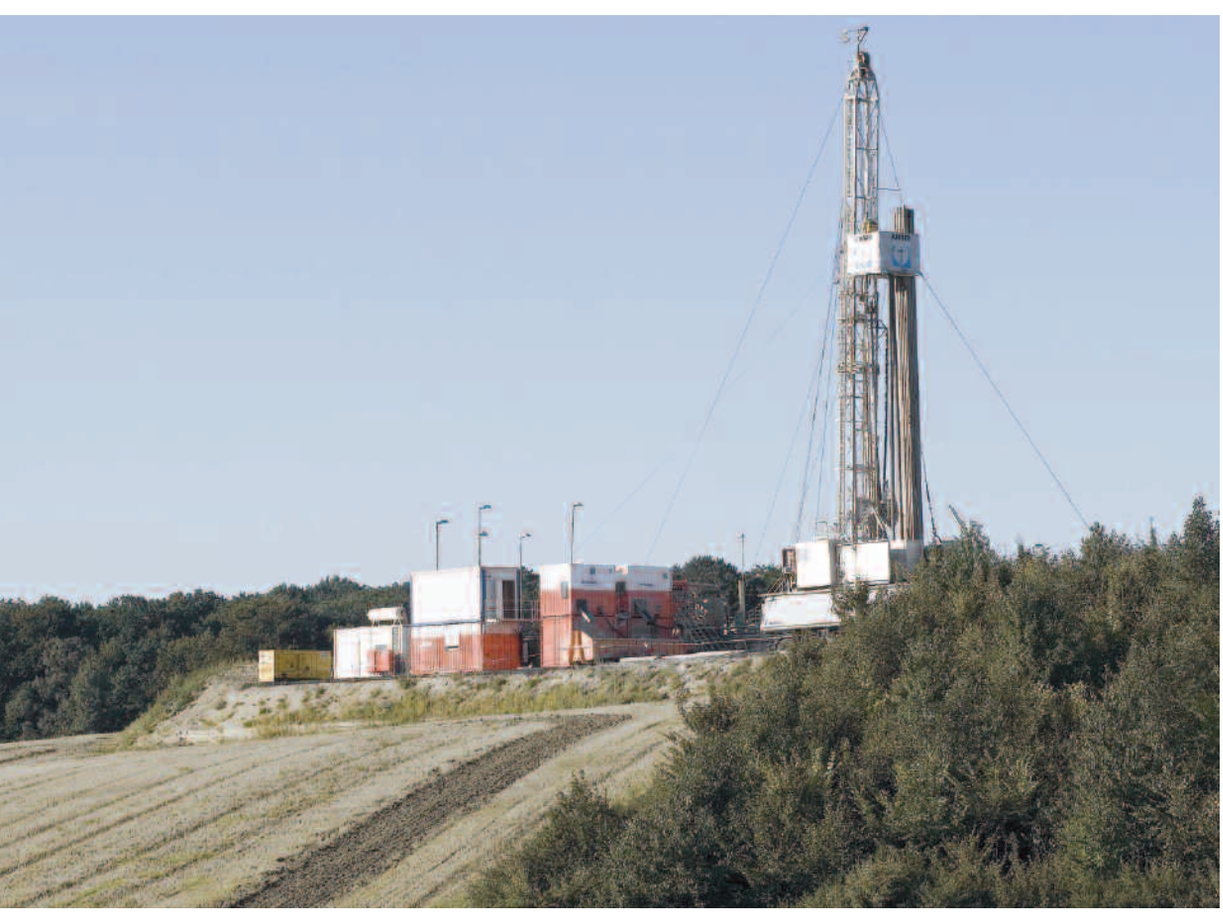
A larger part, though, is provided by two different methods of storage of gas underground. These methods also are of greater importance to us as a drilling company. Here, the gas is stored underground either by the help of so called pore storages or in cavern storages.

Pore storages are naturally existing, depleted reservoirs of oil and gas. The gas that has been produced elsewhere is injected into these existing porous rock layers and stored.

Cavern storages are different in so far as no original reservoirs of oil or gas are used here, but either salt domes or layered salt deposits.

These salt domes or layers are leached by injecting fresh or sea water into them to leach the salt. The resulting salt water is then produced to the surface.

Storage caverns are created by this process for the eventual storage of gas.



Core holes to determine location for gas storage

by storages and unconventional gas

Unconventional gas

In general one distinguishes between conventional and unconventional gas.

The term conventional gas describes gas which can escape freely from pores, ie when the permeability of the rock is large enough to allow the gas escape by itself.

Given this case, it is possible to develop large gas fields with only a few wells, since the permeable rock contains natural connections.

Gas is sometimes referred to as 'unconventional' whenever it exists in reservoirs where the gas is stored within the rock, but will nor flow naturally.

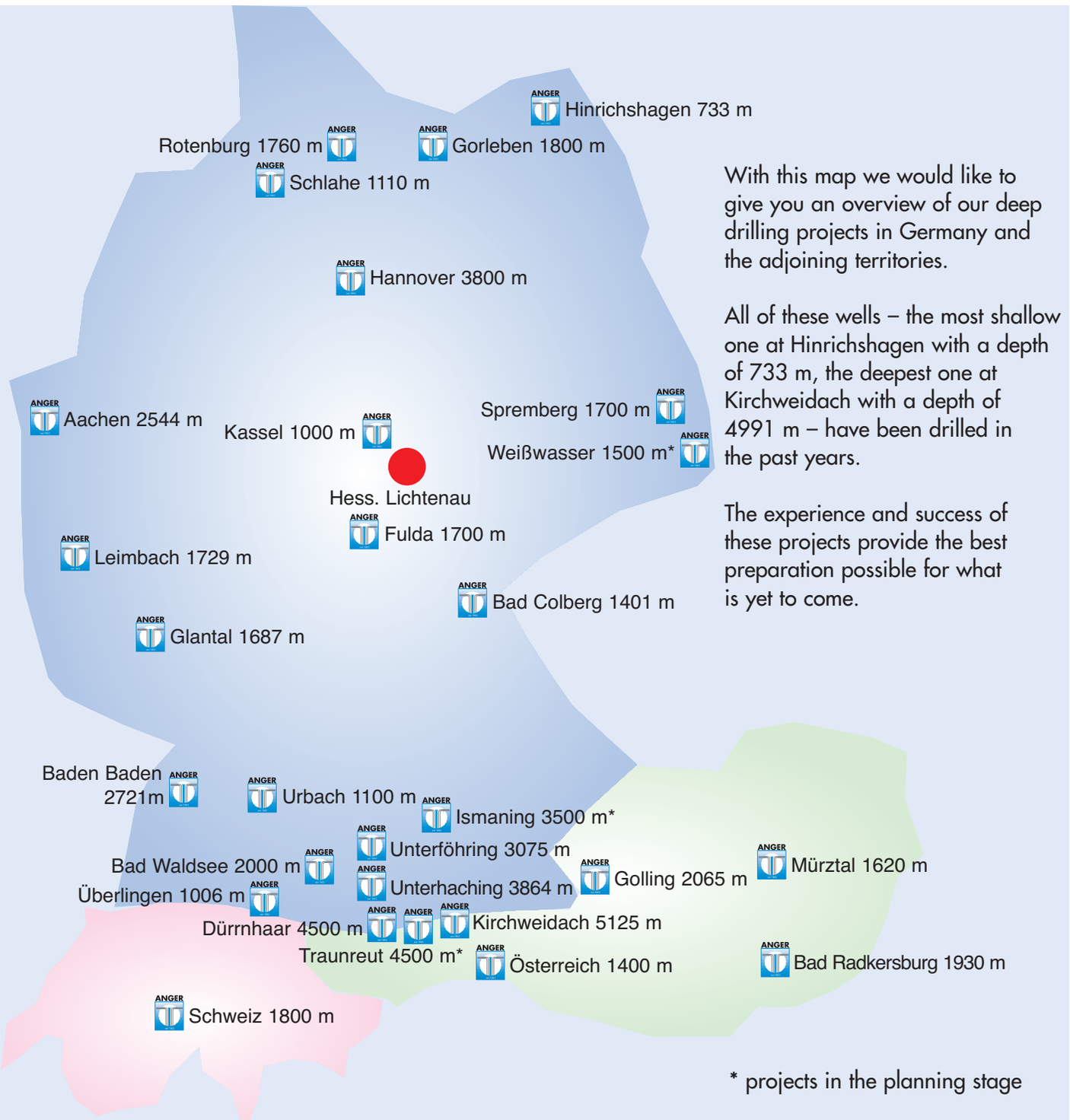
Here, one distinguishes between
- deposits of coal gas: methane gas in the pores or cleats of a coal seam
- tight gas: pores filled with gas in solid rock and
- gas from shales: pores filled with gas in layers of shale

The permeability of the formations in these cases is very low.
In order to be able to use the gas the permeability has to be increased artificially.

In these cases, hydraulic stimulation can be used to create fractures in the host rock. This is sometimes referred to as 'fraccing' whereby a water-sand-mixture is injected into the deep rock layers under high pressure. As a result, drainage fractures develop in the formation and the gas is released.

Technical data
Drilling rig MR 8000
- hook load 200 t
- topdrive
- mud pumps 2x1000 PS
- mud tank 105 m^3

Selected References - Deep Wells



With this map we would like to give you an overview of our deep drilling projects in Germany and the adjoining territories.

All of these wells – the most shallow one at Hinrichshagen with a depth of 733 m, the deepest one at Kirchweidach with a depth of 4991 m – have been drilled in the past years.

The experience and success of these projects provide the best preparation possible for what is yet to come.

* projects in the planning stage

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