Oil and Gas in Germany

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Abstract. In Germany a significant number of sedimentary basins exist, in which hydrocarbon deposits can be found. In this case the North German Basin has the most important position for the oil and gas production and also the reserves. For all that the domestic oil production supplies only about 3.0 % and the domestic gas production 18.3 % of the annual consumption which also results in future in a strong dependence on imports in that sector.

A short survey of the oil deposits in Germany

Germany is divided into several prospective areas which are the foreland of the Alps, Thuringian Basin, Lower Saxony Basin, Oberheingraben, Gifhony Trough, Hamburg Jurassic Trough, West- und Ostholstein Trog and Lausitz (Fig. 2), but the main centers of oil production and reserves are located in North Germany, where especially the areas west of the Ems and in the Westholsteiner Trog are highly profitable (Fig. 1).

![Fig. 1. Statistic of the oil production and reserves 2005/06 (LBEG, 2006)](image-url)
Fig. 2. Prospective areas, oil fields and relating stratigraphic units (LBEG, 2006)
A short survey of the gas deposits in Germany

The prospective areas for natural gas are nearly the same as for oil, e.g. the foreland of the Alps, the Thuringian Basin, the North German Basin and the Oberrheingraben (Fig. 3). In the case of natural gas the centers of production and reserves are in the areas between rivers Ems and Weser respectively Weser and Elbe (Fig. 4).

Fig. 3. Prospective areas, gas fields and relating stratigraphic units (LBEG, 2006)
Significant oil and gas containing stratigraphic units of the North-West German Basin

The North-West German Basin as part of the North German Basin belongs to the great north-west European epicontinental basin, which is located south-western of the Fennoscandian Massif. In the north it borders on the Ringkobing-Fyn-High of Denmark and in the south on the Rhenic Massif, the Hartz Mountains and the Lausitz. In the center of the basin the crystalline basement with its palaeozoic top-set had experienced a deep subsidence. In the following the different plays for oil and gas are listed up in their corresponding geological ages.

Upper Carboniferous

In the Upper Carboniferous a paralic stratigraphic sequence containing sandstones and coal seams exists which is up to 3,000 m thick. In these units the genesis of natural gas began in the Upper Permian and continues until today.

Rotliegend

The Rotliegend is characterized by the set in of continental sedimentation with conglomerates and alluvial fans from the south. This results in an interlocking of fluvial deposits with evaporitic deposits of a playa area to the north. In 1965 the first Rotliegend gas field was opened north-west of Emden (in a depth of 2800-3200 m). In the following years more deposits were discovered between Wustrow and Bremen (in a depth of 3800-4700). The reasons for this important natural gas deposits are the good storage properties of the aeolian sandstones, the direct overlapping of the carboniferous source rocks and the sealing by Zechstein salt.
Zechstein

In the Zechstein the transgression of the Zechstein Ocean takes place. In that case two morphological different units had to be distinguished: The “shelf-platform” and the “basin”. The gas deposits of the Ems-Weser area are related to this “shelf-platform” facies with playa and tidal sediments, at which ooid rocks and dolomite serve as reservoir rocks. This complex is overlapped by several 100m thick sequence of Zechstein salt.

Triassic

The sedimentation of the Triassic overlaps the whole North German Basin where especially the deposits of the Bunter Sandstone are important gas reservoirs, because in some areas the Zechstein salt has moved and the Bunter Sandstone can be found directly over the basal Zechstein with its gas containing Zechstein dolomite. So these areas can be shown as ascent path for gas of the carbon source rocks. At the top these reservoir rocks are covered with clays and salt of the Lower Triassic (Roethian).

Jurassic

In the Lower Jurassic the formation of the Posidonia shale, which is rich in organic substance, takes place. The Middle and Upper Jurassic is also characterized by rift movements which result in the formation of Horst and Graben structures and the set in of hypersaline conditions with cyclic sequences of carbonate, anhydrite and halite.

Dogger

In the Middle Jurassic we have the rising of the “Rheinischen Massivs” and the Pompecki-Block which caused in a more sandy development, the later oil reservoirs. The oil source rock for these reservoirs is the Posidonia shale. All in all the Dogger is only conserved in a few troughs, e.g. Westholstein Trog, Ostholstein Trough, Hamburg Jurassic Trough and Gifhorny Trough, but these are often highly profitable.

Cretaceous

In the Cretaceous we have a marine environment with an anaerobic sedimentation at the turn Jurassic/Cretaceous which resulted in a deposit of thick bituminous clays. In the Lower Cretaceous a clastic sedimentation from the highlands round the Lower Saxony Basin took place until in the Upper Cretaceous the whole North German Basin was covered by clayey and also calcareous-marlaceous beds.
Valanginian

The sandstones of this stage are the most important oil reservoirs of the North German Basin. Moreover the oil is generally found in anticlinal reservoirs, at which in the western Emsland bituminous clays of the Lower Cretaceous are identified as source rock whereas in the eastern Emsland a combination of Posidonia shale and bituminous clays predominates.

The oil field Mittelplate

The oil field Mittelplate is in the Westholsteinschen Juratrog in front of the western coast of Schleswig-Holstein (Fig. 5). There the oil is produced from sandstones of the Middle Jurassic and Lower Cretaceous (depth 1900-3000 m). This deposit is related to the fact that the sandstones are dragged on the flank of the Büsumer salt stock and their revelation by clays. The first oil well was started in 1964 and in 1984 the production began. Since 2000 extended reach drillings from the land station “Diecksand” exist and in the future another 14 drillings are planned, also to explore the top of the “Büsumer” salt stock on further deposits (Fig. 6). In 2005 a new drilling rig has been installed on Mittelplate, which allows a greater radius of action. Also in 2005 the pipeline connection between Mittelplate and the land station Diecksand was finished. Regarding to these facts the production capacity of Mittelplate and Dicksand will rise up to 2.5 Mt in 2007.

Fig.5. Site plan of the oil field Mittelplate and its connection to the mainland in the national park “tideland of Schleswig-Holstein” (green area) (Stachel, 2002)
Actual and future efforts on oil and gas prospection in Germany

In general the historical low level in drilling operations was in the year 2003 and since then there is an upcoming trend in the drilling activity (2005: 42 projects with 65024 m, Fig. 7), because of the long-term high oil price. This trend is caused by an upcoming prospection in stratigraphic units of the North German Carboniferous and Rotliegend and also in the South German Molasse Basin. In connection to that there is also a higher use of geophysical methods for the underground exploration, especially of 3D-seismic and gravimetry surveys. Nevertheless are the oil reserves going down because the decline in all deposits is higher than the actual production (Fig. 8). Even the high oil price has not lead to a higher rating of the several deposits. In the case of natural gas there is an overall strong decline since five years, but in the last year the initial reserves have risen, because of several successful drilling projects and higher ratings of many gas deposits (Fig. 9).

Fig. 6. Cross section of the Büsumer salt stock and the oil field Mittelplate with its land station Diecksand (Stachel, 2002)
Fig. 8. Oil reserves statistic (LBEG, 2006)

Fig. 9. Gas reserves statistic (LBEG, 2006)
References


