European Network for Research in Geo-Energy

Assessing the potential for storage of renewable electrical energy in salt caverns in the border area between Denmark and Germany (southern Jutland – Schleswig)

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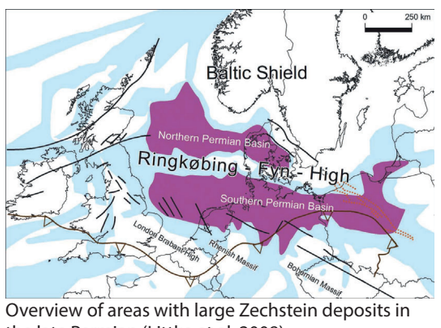
GeoPower project – energy storage

In order to meet short-term needs, power plants with compressed air storage are particularly suitable; here the excess electrical energy is stored in the form of compressed air in caverns. In order to meet more long-term needs, especially hydrogen storage systems can be a good solution, where the excess electricity supplied is used for the production of hydrogen. GeoPower project an Interreg 4A projekt.

Background

In the border area between Denmark and Germany (southern Jutland – Schleswig), the GeoPower project mapped sandstones constitutes a potential source of geothermal energy and salt formations with good conditions for energy storage.

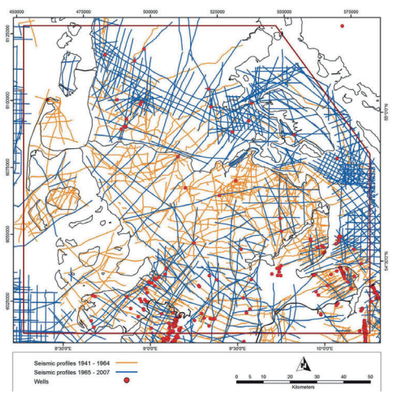


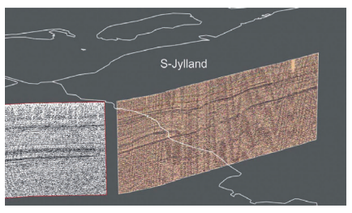
Overview of areas with large Zechstein deposits in the late Permian (Littke et al. 2008).

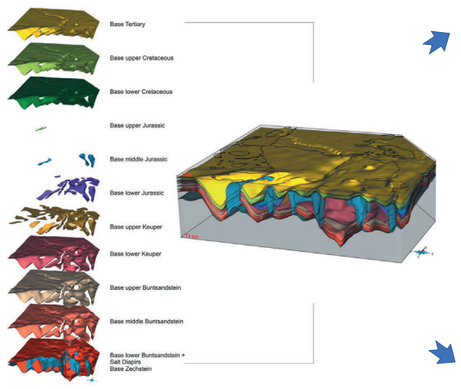
GeoPower project area.

Methods

A multidisciplinary study including interpretation of petrophysical logs, seismic data, core analysis data, petrography, provenance, temperature data and pore water chemistry data has been performed in order to assess the geothermal potential in the southern Jutland – Schleswig area. Data coverage is excellent with 7 wells and 2D and 3D seismic surveys.

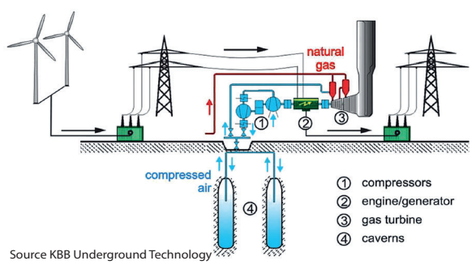




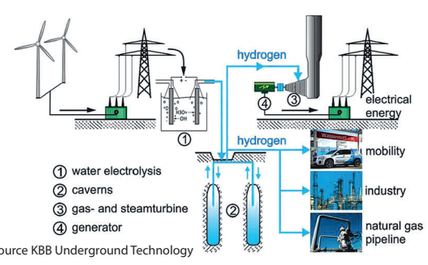


Results

The multidisciplinary characterization of the Bunter Sandstone Formation in the Tønder area has produced a state of the art geological model with special attention paid to reservoir properties of the upper and lower Bunter sands. The model serves as input to a 3D reservoir simulation study. The mapping showed distribution of horizons with potential locations of caverns to store compressed air as well as distribution of horizons with potential locations of caverns to store compressed hydrogen.



Source KBB Underground Technology



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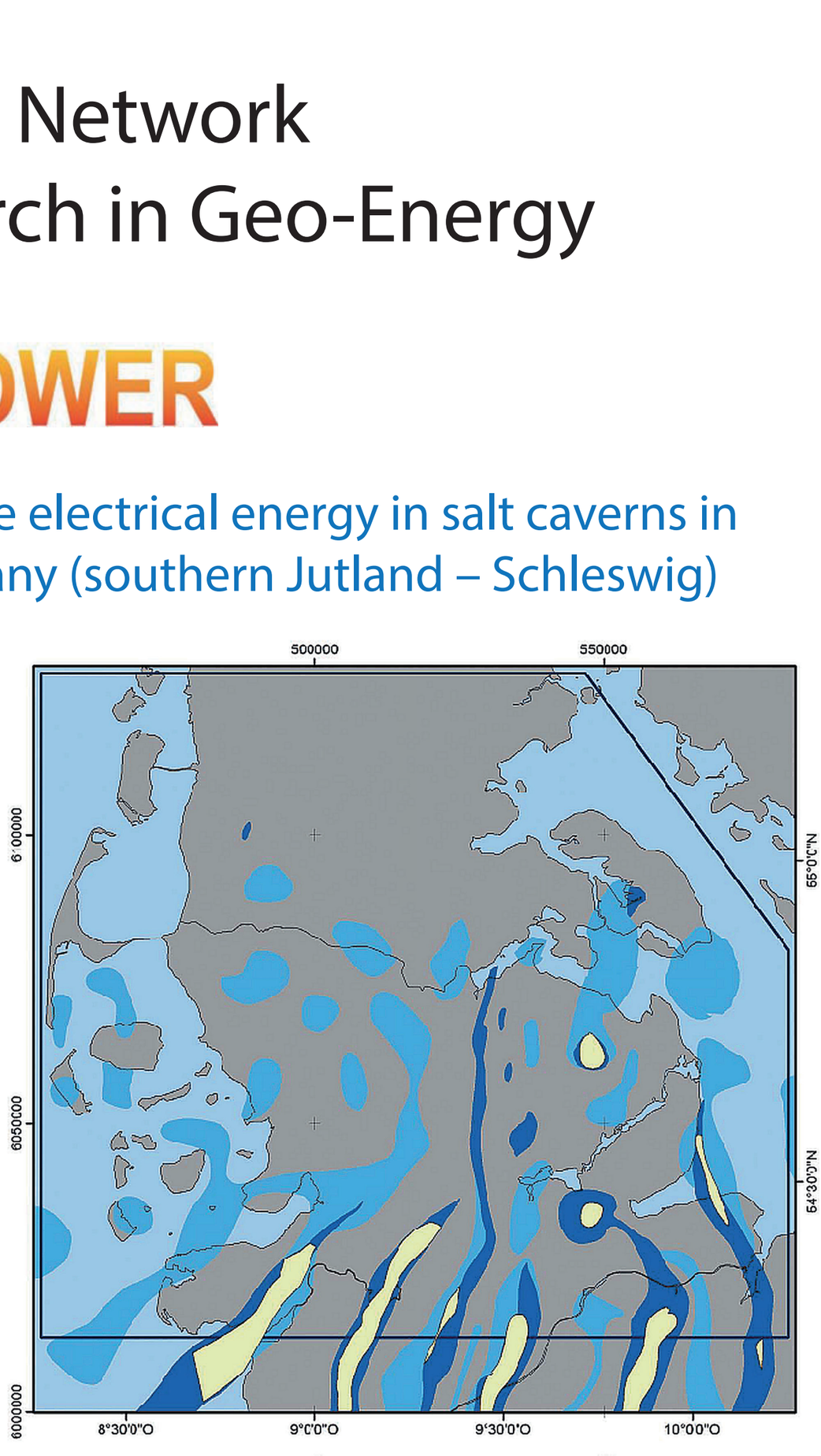
Geological conditions for energy storage in salt caverns

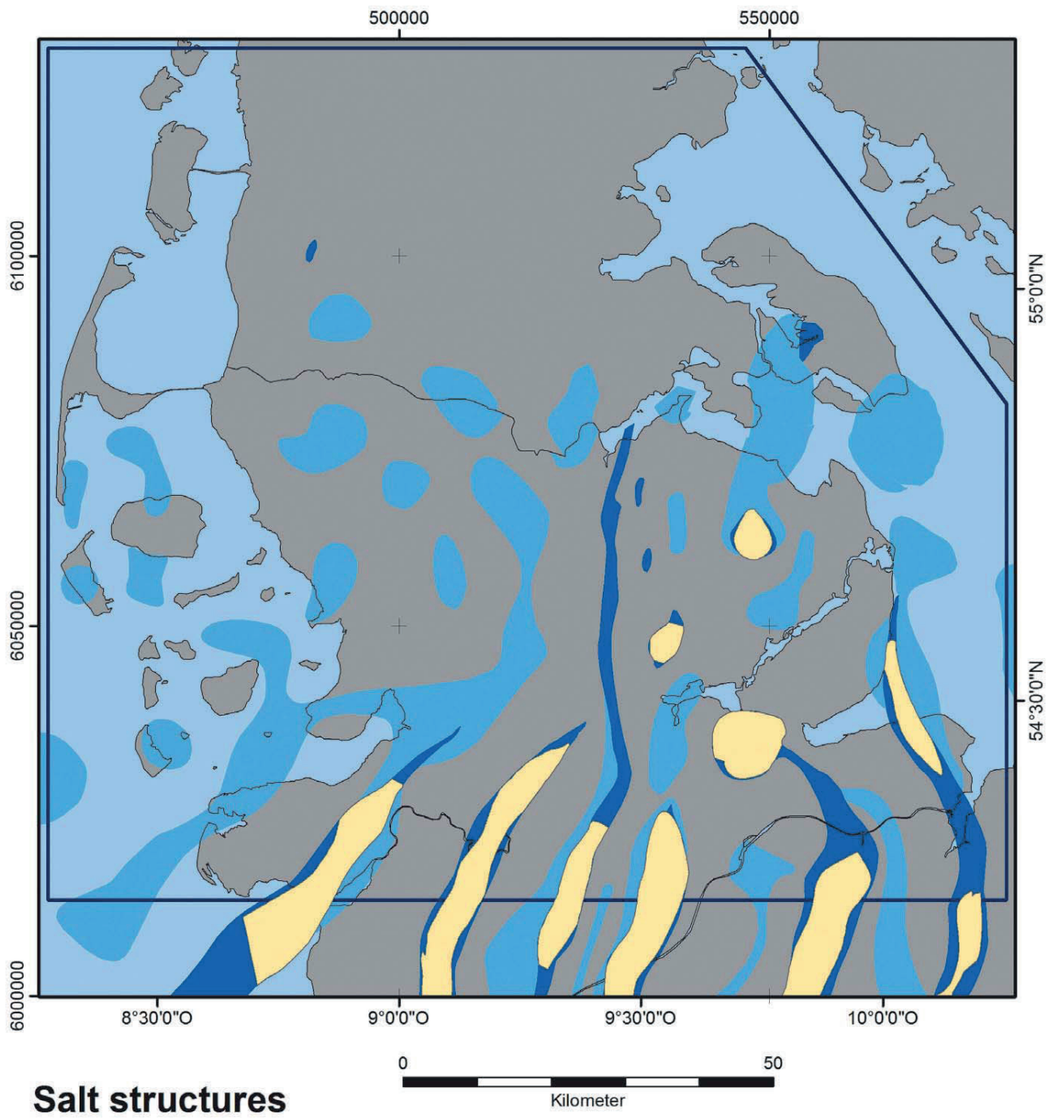
Important geological criteria for the creation of storage caverns in a salt formation are the depth, power, and salt quality. In addition, the internal structure is significant, especially with regard to the distribution of soluble, highly soluble and insoluble components. They can have a great influence on the rock mechanical and the mechanical effects of rock. In addition, the temperatures, rock pressures, pressure changes in the storage and their mechanical properties must be considered in terms of long-term stability and cavern integrity.

The cavern design depends not only on the local geological conditions, but also on the operating conditions. In this context, the requirements of compressed air storage differ significantly from those of hydrogen storage when it comes to the exploitable depth of the salt structures. Caverns for compressed air storage can be operated at a depth of 50-100 bar only at a depth between 500 and 1300 m. The configuration of hydrogen storage caverns is similar to that of modern natural gas caverns in terms of volume (about 500,000 m^3), drilling location, pressure (60-180 bar) and drilling.

The rim depth of the salt structures is not suitable for creating storage caverns because overhangs are formed. In the seismic studies, these salt overhangs cannot be clearly delineated from the surrounding rock. Therefore, relative to the overhangs, it is not possible to smoothly map the areas with potential storage locations.



Distribution of horizons with potential locations of caverns to store compressed air.



Distribution of horizons with potential locations of caverns to store compressed hydrogen.

Web-stites

www.llur.schleswig-holstein.de (LLUR)
http://dybgeotermi.geus.dk/geotermikort/ (GEUS)

Reference:
LITTKE, R., BAYER, U., GAJEWSKI, D., NELSKAMP, S. (Eds.)(2008): Dynamics of Complex Intracontinental Basins - The Central European Basin System.-Berlin, Heidelberg (Springer)

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