Ministry of Economic Affairs and Climate Policy

Dinantian carbonates

Exploring potential for hydrocarbons and geothermal energy

The Lower Carboniferous Dinantian carbonates have recently become the target of exploration for both hydrocarbons and geothermal energy in the Netherlands. Evaluation of recent O&G and geothermal wells in Belgium and the Netherlands, combined with seismic mapping (e.g. Hoornveld, 2013 and Boots, 2014) has resulted in a new mapped distribution of Dinantian carbonates (see fig. 1) and has led to a better insight in the mechanisms leading to favourable reservoir quality.

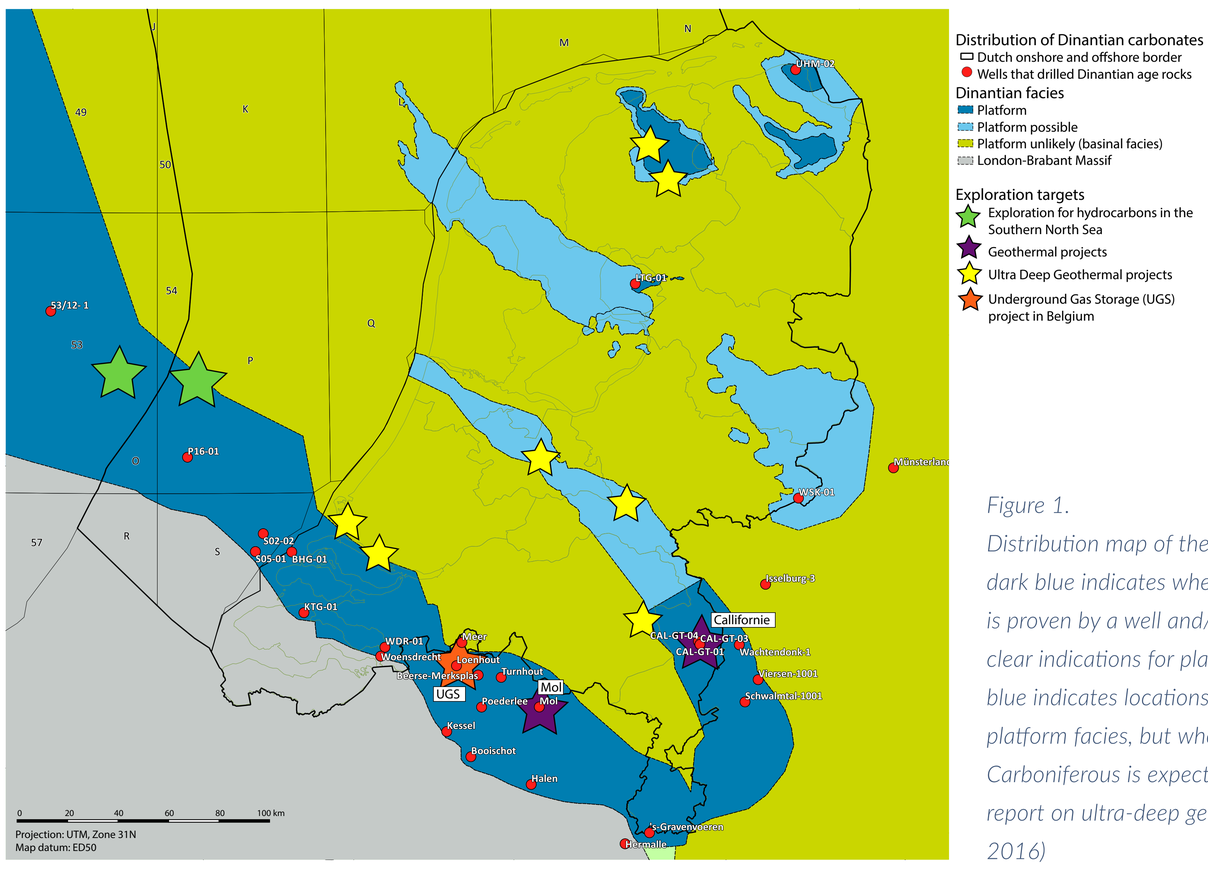

Figure 1.
Distribution map of the Dinantian carbonates. The dark blue indicates where a carbonate platform is proven by a well and/or where the seismic has clear indications for platform structures. Light blue indicates locations without direct proof of platform facies, but where a local high in the Early Carboniferous is expected. (Modified from a TNO report on ultra-deep geothermal energy, Boxem et al., 2016)

Changing views on reservoir quality: From tombstone to cave

Dinantian carbonates have been underexplored because of the misconception that these rocks are always tight. Wells and seismic data, however, show the presence of fractured and karstified (producing) reservoir. Underground gas storages wells in Belgium and recent geothermal wells in the Netherlands and in Belgium found highly permeable reservoir (fig. 2).

Figure 2.
Core with karstified Dinantian carbonate rock from Belgian UGS well.

Prospective targets

- The conceptual diagram in fig. 3 shows the different scenarios for karstification and/or fracturing of Dinantian carbonate reservoir – to be explored for.
- The prospective structures indicated in fig. 3 can be recognized on seismic data (see figs. 4 & 5).

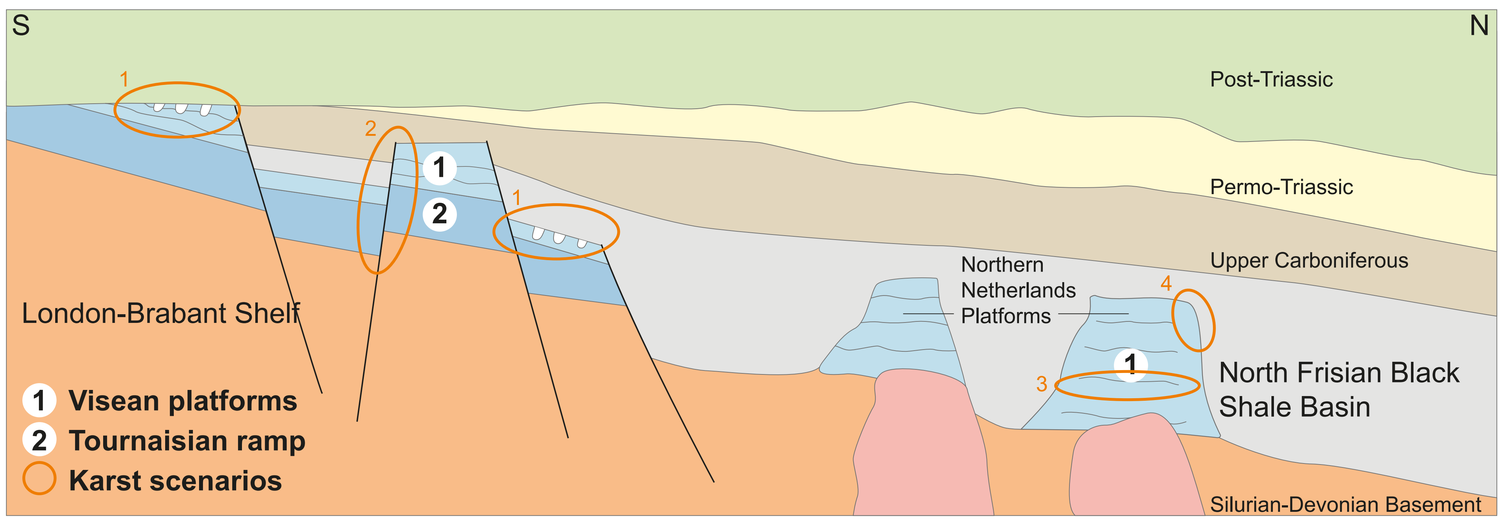

Figure 3. Locations with a higher chance of karstification are indicated by orange ellipsoids. 1 Meteoric karstification takes place when the rocks are exposed at surface and fresh water flows through faults and fractures. 2 Hydrothermal karstification takes place when hot fluids flow upwards through deepseated faults. These fault zones will be fractured as well. 3 Intra-platform karstification takes place during sea level low stands in between periods of carbonate platform development. Indications for these first 3 scenarios have been found in wells and seismic data in recent studies. 4 Mixed coastal-zone karstification can occur when a carbonate platform is exposed to a mix of fresh and salt water. The edges of the platform will also be more prone to fractures as a result of slope instability.

Exploration targets

- Offshore, in the P-quad, the Dinantian carbonates are being explored for hydrocarbons by a partnership led by Jetex.
- Onshore, an Ultra Deep Geothermal exploration work programme is being set up by EBN and TNO. This programme explores the potential of the Dinantian Carbonates to supply high temperature heat (> 150 °C) to the process industry. The programme starts in early 2018 and will be coordinated by EBN.

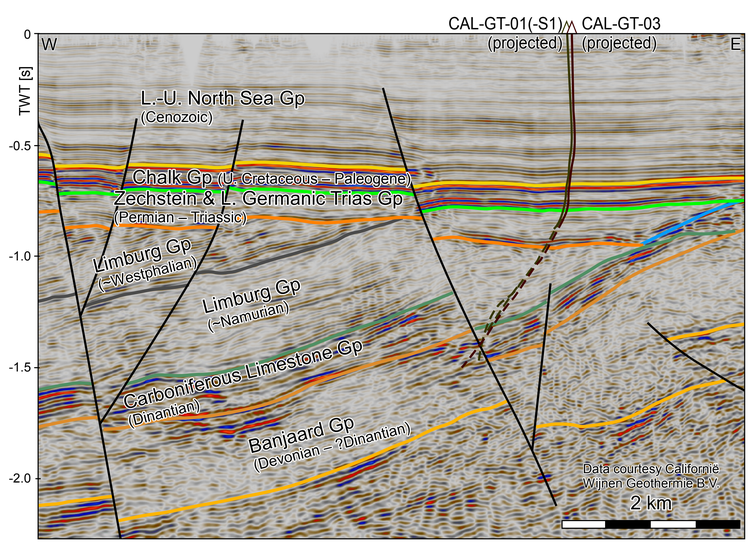

Figure 4. Seismic line through geothermal wells CAL-GT-01 and -03. This well (-01) encountered a cavity larger than 30 m and produces 240 m^3/h. The seismic shows that the well was drilled into a fault zone. Evaluation of samples indicates that the karstification and dolomitisation were caused by hydrothermal diagenesis (Poty, 2014).

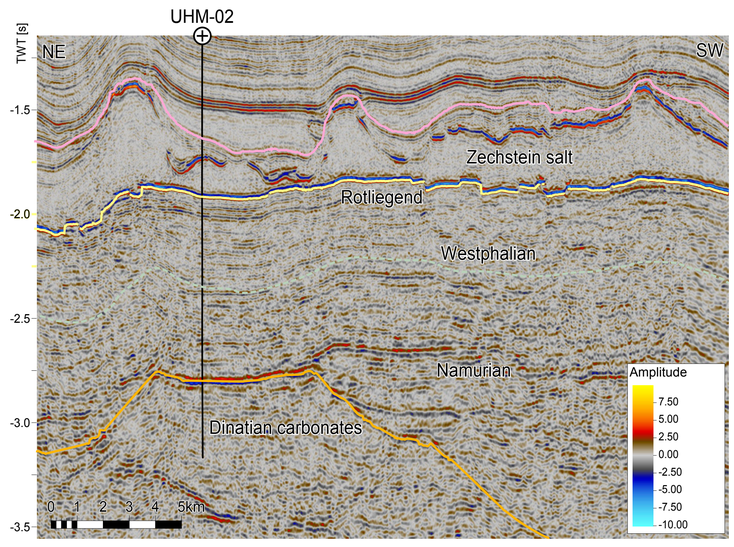

Figure 5. Example of a Dinantian carbonate platform visible on seismic. The well UHM-02 was drilled in the platform interior encountering a few, thin, karstified zones. More fractured and karstified, hence more permeable, carbonate rock may be found at the edges of the platform.

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