



## Microseismic monitoring of an underground gas storage facility in the Netherlands

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The Bergermeer field is a natural gas reservoir in the North-Western part of the Netherlands. The reservoir geometry is defined by a horst structure at 2km depth that consists of two major blocks (partly) separated by a large central scissor fault. The reservoir rock is a sandstone of Permian age from the Slochteren formation. The top and side seals consist of a series of evaporites from the Zechstein formation.

The field has been in production from 1970 to 2006. During the production two pairs of widely felt and slightly damaging earthquakes with local magnitudes between 3.0 and 3.5 have been induced. After the first pair of events in 1994 a local 3-station seismic network of shallow borehole sensors was installed. This network, with a local detection capability in the order of magnitude 1, has not detected any local seismicity apart from the second pair of strong events in 2001. The hypocenters of all four events have been located close to the central fault, near the "hinge of the scissor".

Currently, the Bergermeer field is being prepared to be operated as an underground gas storage facility. This preparation includes the injection of cushion gas. To extend the seismic detection capability down to the microseismic level a downhole seismic tool has been installed at reservoir level. The tool consists of six three-component geophones with a spacing of 10m.

We present a case study of our recent results in the microseismic monitoring of the Bergermeer field, with an emphasis on the accuracy and resolution of microseismic event location. The current rate of detectable seismic events is in the order of a few events per week. The magnitudes of the detected events range from -3 to -1.