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Recent seismicity in the northern German gas fields - induced and tectonic?

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In the northern German gas fields, several ML 2 to ML 3 earthquakes per year happened during recent years. Seismicity is generally bound to some 5 km depth corresponding to the exploited gas reservoirs in the Rotliegend. Thus this seismicity is assumed to be probably related to the conventional gas extraction. For liability claims, the regional seismic monitoring has improved recently by several new stations operated for the Wirtschaftverband Erdöl- und Erdgasgewinnung (WEG) - an industry consortium of gas producers - and the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) - the German federal governmental agengy for geosciences and resources.

In the context of the DGMK research project 761, Stuttgart university has installed an additional, small-scale seismic network that monitored the Rotenburg region for the last two years. The region was chosen on purpose since 2004, the ML 4.5 Rotenburg earthquake was the largest event ever recorded in the vicinity of conventional gas production. For our monitoring, we combined one 10-station array with two tri-partite small arrays and five 3C single stations. Our installation covers an area of 11,5 km by 16 km. Within this area we achieved a detection threshold of ML 0.5 as verified by 35 events in a distance range of up to 100 km. In spite of this sensitivity no small events were observed near Rotenburg as would have been expected from the past seismicity by the two major earthquakes Rotenburg 2004 (ML 4.5) and Visselhövede 2012 (ML 2.9).

Reprocessing WEG and BGR data from the past by cross correlating seismograms from those 35 recent events we found additional events also clustering at 5 km depth. Additionally we discovered four singular, deeper earthquakes at 25 km to 30 km depth which previously were overlooked in regional monitoring due to many noise bursts by military shooting. Possible source mechanisms for these deeper events will be discussed ranging from the existence of intraplate earthquakes to the stress release from postglacial isostatic relaxation.