Geophysical Research Abstracts
Vol. 20, EGU2018-6019, 2018
EGU General Assembly 2018

Mapping and modelling of collapse sinkholes in soluble rock: the Münsterdorf site, northern Germany

Georg Kaufmann (1), Douchko Romanov (1), Thomas Tippelt (2), Thomas Vienken (2), Ulrike Werban (2), Peter Dietrich (2), Franziska Mai (3), and Frank Börner (3)

(1) Freie Universität Berlin, Geophysics, Dept. of Geological Sciences, Geophysics Section, Berlin, Germany (georg.kaufmann@fu-berlin.de), (2) Department Monitoring- und Erkundungstechnologien, Helmholtz-Zentrum für Umweltforschung - UFZ, Permoserstr. 15,04318 Leipzig, Germany, (3) Applied Geosciences, Geophysics Section, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany

Münsterdorf is a small village in the north of Hamburg, located along the northern rim of a salt diapir. The Permian rocks are uplifted and overlying rocks such as the cretaceous limestone, normally in several kilometres depth, have been pushed up close to the surface. In Münsterdorf, the cretaceous limestone can be found in around 20 m depth, and about 2 km further south, cretaceous limestones are quarried in a large open-pit mine.

Since 2004, collapse sinkholes form on a sports field in Münsterdorf, with a frequency of about 1 every two years, about 3-5 m in diameter and 3-5 m deep. The collapse sinkholes do not reach the underlying limestone, but seem to be related to accelerated dissolution in that formation. Above the cretaceous limestone, quaternary gravels and glacial tills provide a non-soluble, but permeable and heterogeneous cover of about 20 m thickness.

We have mapped the sports field and its vicinity with gravity (GRAV), electrical resistivity imaging (ERI), self-potential measurements (SP), spectrally-induced polarisation (SIP), and ground-penetrating radar (GPR). While GRAV and SP is fairly unspectacular, the ERI profiles indicate a significant change in the surface layer, from thin and irregular in the northern part to thicker and more homogeneous in the southern part of the sports field. GPR profiles and the SIP borehole monitoring confirm this result.

We numerically model the evolution of flow and porosity in the cretaceous limestone to estimate the evolution time of subsurface voids in the limestone, and we discuss the potential cause of the sinkhole formation and its sudden onset in light of the hydraulic boundary conditions.