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Petrophysical Effects during karstification

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Sinkholes are depression or collapse structures caused by dissolution in the subsurface or subrosion processes and occur in a vast variety of geological settings. They pose a considerable threat to people's safety and can cause severe economic loss, especially in highly populated areas. Commonly, sinkholes are linked to anomalies in groundwater flow and to the heterogeneities in the soluble sediment.
To develop an early recognition system of sinkhole instability, unrest and collapse it is necessary to obtain a better understanding of sinkhole generation. With this intent the joint project "SIMULTAN" studies sinkholes applying a combination of structural, geophysical, petrophysical, and hydrological mapping methods, accompanied by sensor development, and multi-scale monitoring.
Studying the solution process of gypsum and limestone as well as the accompanying processes and their relation to hydrologic mechanisms from a petrophysical point of view is essential to understand geophysically detected anomalies related to sinkholes. The focus lies on measurements of the complex, frequency dependent electrical conductivity, the self potential and the travel time of elastic waves. First, systematic laboratory measurements of the complex electrical conductivity were conducted on samples consisting of unconsolidated sand. The fully saturated samples differed in the ionic composition of their pore water (e.g. calcium sulfate and/or sodium chloride). The results indicate that it is possible to detect effects of higher gypsum concentration in the ground- or pore-water using electrical conductivity. This includes both the karstificable sediments as well as the adjacent, non-soluble sediments like e.g. clean sand or shaly sand.
To monitor karstification and subrosion processes on a field scale, a stationary measuring system was installed in Münsterdorf, Schleswig-Holstein in northern Germany, an area highly at risk of sinkhole development. The complex electrical conductivity is measured in two boreholes, located 5 meters apart. The results of these measurements are used to investigate possible solution of the subterranean chalk.