

Geophysical Investigations During Pump Testing in a Quaternary Aquifer

¹KESSELS, W., ²FABIAN, M., ¹FULDA, C., ¹GABRIEL, G., ²KUEMPEL, H.J., ²REBSCHER, D., ¹WIEDERHOLD, H., ¹WONIK, T., ¹WORZYK, P., ¹ZOTH, G. ¹Institute for Joint Geoscientific Research (GGA), Hannover, Germany; ²Geological Institute of the Rheinische Friedrich-Wilhelms-University, Bonn, Germany

The upper aquifer in the test region between Cuxhaven and Bremerhaven in northern Germany mainly consists of tertiary and quaternary sediment deposits (up to 500 m thick). The boundary between Quaternary and Tertiary lies about 20 - 50 m below sealevel except for two groundwater focusing quaternary channels reaching down to 300 m below sealevel. Quaternary channels are filled with sand and gravel sediments. For water management the coarse sediments are very important as high conductive drinking water reservoirs.

During a pump test with flow rates of about 300 m³/h and high sensitive hydraulic measurements an intensive geophysical monitoring was carried out. The results of hydraulic, geoelectric, seismic, and geomechanic studies during the pump test "Wulsdorf" are presented. Geoelectric measurements on the surface and in the observation wells were carried out in order to investigate saltwater moving during the pump test. Results show that measurements of the electric potential in observation wells are sensitive enough for interpretation. Time dependent gravity observations don't show significant signals but a geomechanical effect can be deduced from precise levelling. Ground deformation measurements with tiltmeters were performed in two boreholes 70m and 140m away from the pumping well. Pumping induced ground deformation was found at the 70m position in contrast to the 140m position where no deformation could be detected. Amplitude and direction of the ground deformation cannot be explained by analytical halfspace solutions. In areas where the quaternary aquifer is characterized by "Lauenburger clay" a clear "nordbergium" effect is detected by high-sensitive air pressure corrected piezometer measurements.