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Seismic surveying to explore the transition zone around caverns in salt rocks

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Salt deposits can be influenced by fluid entries due to geological fracture zones or the solution of technical caverns, e.g. as energy storage space. The aim of the seismic surveys within the GEO:N project ProSalz is to further investigate these fluid occurrences and their migration into the developing transition zone between cavity and undisturbed salt rocks by using tomographic and pre-stack migration methods. Two different seismic surveys are performed to image structures in salt rocks close to a geogenic cavern and an artificially created field-test cavern within a salt pillar. Changes within the salt rocks close to the geogenic cavern are determined by travel time tomography, in particular p-wave tomography and p/s-wave tomography in 2D and 3D. The first evaluation of the seismic data set revealed an average p-wave-velocity of 4.60 km/s and an average s-wave-velocity of 2.63 km/s in salt rocks. Furthermore, the potential velocity gradient towards the cavernous structure will be evaluated and compared to geochemical experiments. The signals of reflected waves can possibly be used to distinguish between fluid-filled and dry areas to explore potential fluid pathways within the salt body. Similar methods are used to monitor effects around the field-test cavern by installing a seismic sensor array around the salt pillar. The seismic monitoring at the salt pillar is performed in the frequency range of 100 Hz to 14000 Hz resulting in a spatial resolution in the cm-range. The main focus of these measurements is to detect the dm-sized field-test cavern within the pillar and to monitor the expected evolution of a fluid-migration in its vicinity. Due to the application of a similar seismic measurement system, the results of the field-test cavern can be directly related to geogenic and technical caverns and help to improve the process understanding of the multiphase transport (salt-water-gas) in the transition zone between cavity and solid rock.