Seismic surveys at an artificially created field-test cavern within a salt pillar

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Salt rocks serve as host rock for technical caverns due to their impermeability but their can also be influenced by fluid migration due to geological fracture zones. Seismic methods can be used to monitor cavernous structures in the transition zone between cavity and undisturbed salt rocks. Around an artificially created cavity (field-test cavern) in a salt pillar with a volume of approximately 100 litre, travel time tomography was utilized to image structures related to caverns and fluid-storage. Seismic surveys were performed at different stages of an experimental simulation of gas-water-rock interaction in the field-test cavern aiming for a better understanding of the multiphase system in the cavern-near area. The baseline survey (1) was carried out using 8 three-component piezo-electrical sensor rods and a seismic vibrator source at the surface of the salt pillar, first without an installed field-test cavern. After drilling and installing the field-test cavern, seismic cross-hole measurements were performed after producing partial vacuum in the test cavern (2) and infill of gas (3) and water (4). To finalize the field experiments the last seismic survey (5) was again conducted at the surface of the salt pillar as a repeat measurement to the baseline survey. The seismic monitoring of the salt pillar was carried out in a frequency range of 100 Hz to 14000 Hz allowing a spatial resolution in the cm-range. This was followed by pre-processing of the seismic data sets to apply the picked travel times in a tomography program. On the basis of the tomography results and reflection seismic data we want to assess the potential enlargement of the field-test cavern due to water-infill and to image the differences between unaffected salt rocks, cavernous structures and developing transition zones.