Fault detection with Ground Penetrating Radar and Cross-Borehole Ground Penetrating Radar for subsurface mining safety

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We apply Ground Penetrating Radar (GPR) and Cross-Borehole Ground Penetrating Radar (XBGPR) in an underground marble mine for fault detection and for a better understanding of the local stress regime. Fault detection is an ongoing safety issue in the mining industry, especially in underground situations. Detailed information about faults and fractures reducing rock stability have crucial impact on further mining activities. If faults are water filled, they can be detected by GPR. Boreholes are often drilled in advance of mining to clarify the locations of ore bodies and gangues. They can be used for cross borehole analyses and computed tomographic images can supplement conventional borehole imaging. For the acquisition of the XBGPR we have drilled 4 boreholes along a profile with increasing offset from 5 to 25 meters. The acquisition was performed with a 100 Hz antenna using a transmitter and receiver step size from 0.5 to 1 meter. The computed tomographic images were created until a depth of up to 30 meters and are complemented by the GPR measurements in reflection mode. GPR imaging was performed along the 25-meter-long profile with 100 Hz and 250 Hz antennas. A self-made shield was built for the unshielded 100 Hz antenna, comparing imaging results is showing improvement due to our construction. We discuss the tomographic images of the XBGPR in combination with the GPR results for a better understanding of rock stability influencing mining activities.