Geophysical Research Abstracts
Vol. 12, EGU2010-4134, 2010
EGU General Assembly 2010

Ground Penetrating Radar, a Method for Exploration and Monitoring of Coal Fires in China

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Due to the climate change it is a global task to fight against gas emission of coal fires. In China exists many burning coal seams which should be extinguished. A Chinese-German initiative tries to find new technologies and solutions to control these fires. Most of the fires are close to the surface in arid areas. In that case GPR is a possible geophysical method to get detailed information about the structure of the soil. Mining activities and the burning coal are leaving voids which collapse or still exist as dangerous areas. With GPR it is possible to detect voids and clefts. Crevices are potential paths for oxygen transport from the surface to the fire. The knowledge of these structures would help to extinguish the fire. The heat of the burning coal changes the permittivity and the conductivity of the rock. This affects the radar signal and makes it possible to separate burning zones from intact zones. Monitoring of the burning zones helps to find optimal solutions for fire extinguishing strategies.
Several field campaigns were made in China. One campaign was in the province Xinjiang with a 50 MHz system from Mala on a steep dipping coal seam. Other campaigns were in the Inner Mongolia with 40 MHz to 200 MHz antennae from GSSI on shallow dipping coal seams. The experiences from these measurements will be shown. The surveys were collected in rough terrain. The data from the unshielded antennae contained a lot of effects coming through the air. The limits of detecting crevices with GPR will be demonstrated. Some parts of the measurements over burning coal were influenced by strong anomalies of the magnetization. Modeling of the radar signal helps at the interpretation. Parts of the interpretation from the surveys can be validated by the outcrop of the investigated structures. A spatial visualization of the results is the basis for discussions.