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# Repeated Geophysical Surface Measurements to Estimate the Dynamics of Underground Coalfires

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Spontaneous combustion of coal has become a world wide problem caused by and affecting technical operations in coal mining areas. The localization of the burning centre is a prerequisite for any planning of fire fighting operations. For the German - Chinese coal fire project sponsored by the German Ministry of Science and Technologies (Grant No. 0330490K) two firezones, namely the so called fire zone 18 of the coal mining area of Wuda (Inner Mongolia, PR China) and the firezone of Queergou (Xinjiang, PR China) are currently monitored by geophysical measurements.

For the geothermal and geochemical mapping 25 up to 1m deep boreholes with a diameter of approx. 30 mm are distributed over the particular firezone. To avoid highly dynamic gas flow processes in fire induced fractures caused by weather conditions, all boreholes were situated in the undisturbed rock compartments. In these boreholes, plastic tubes of 12 mm diameter provide access to the borehole ground filled with highly permeable gravel. The boreholes are otherwise sealed by clay.

The geothermal observations consist of measurements of temperature profiles in the boreholes and thermal conductivity measurement on rock samples in the lab. The derived heat flow with maximum values of 80 W/m2 (Wuda) is more than three orders of magnitude higher than the natural undisturbed heat flow. The high heat flow suggests that the dominant heat transport is gas convection through the system of porous rock and fractures.

The geochemical soil gas probing is performed by gas extraction from the boreholes. Measured are the concentrations of O2, CO, CO2, H2S and CH4. The O2 deficit in the soil air and the concentrations of the other combustion products compared to the concentrations in the free atmosphere are related to the combustion area.

A magnetic mapping has only been performed in Wuda with point distances of 2 m and profile-distances of 3 to 4 m covered an area of 350 [U+F0B4] 300m with 7913 points. The detected anomalies lie in a range between –130 and 176 nT. The maxima are most likely caused by the conversion of pyrite and markasit into maghemite, hematite and magnetite. Therefore the identified patches with high magnetic anomalies should have a direct connection to the burning coal in firezone 18.

The firezone in Wuda has been visited now for five, that in Queergou for two times. All the discussed geophysical measurements together allow an integrated interpretation. Each result can be related to the combustion process with a particular likelihood for the vertical projection to the combustion centre. Probability calculations with chosen weight factors for each observation method are discussed. A so called fireindex deduced from the repeated measurements reveals the dynamics of the coal fire.