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Petrophysical experiments for coalfire fighting by using saltwater in the Wuda Coal Mining Area

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Spontaneous self ignition of coal causes an immense emission of climate relevant gases and affects regional groundwater conditions in such a large scale, that it could not be even rough estimated. This problem occurs all over the world where coal is mined, stored or processed. Keeping these things and also global warming problems in mind, the extinction of such fires becomes a significant task for future climate and environmental protection. In the big arid coal mining belt of the northwest PR China the necessity of environmental as well as resource protection is now realized, leading to increased fire fighting activities. Mostly, the burning coal is partially removed, the surface is insufficiently sealed from oxygen and fire-zones are cooled with valuable fresh water. Such cooling of fire centers is often not sustainable because oxygen rich air may keep on penetrating the soil surface and reach the cooled down coal which subsequently starts to burn again.

Within the Sino-German project "Innovative Technologies for Exploration, Extinction and Monitoring of Coal Fires in North China" a numerical model has been developed to simulate the propagation of underground coal fires in realistic scenarios. This model will be adapted to new data from lab and field experiments, now including multiphase transport and phase transition processes.

Nevertheless the basic behavior of coal fires depends on the transport and supply of oxygen in the subsurface and therefore mainly on the permeability, thermal conductivity and specific heat capacity of the material. Because of this, systematic experiments, carried out in the laboratory on soil samples and petrophysical investigations

of reservoir rocks, yield the functional dependency of these parameters on the salt content of the material. The experiments have shown that if salt water is injected into high temperature zones of burning coal or even used for rewetting an oxygen isolating sand cover, water will evaporate and the salt will crystallize. Besides the cooling effect, the pores of the permeable rock will be partially closed by salt crystals. The resulting lower permeability will prevent further oxygen transport. Besides that, the salt significantly increases the thermal conductivity in the mostly fractured rock/coal and heat flow is enhanced. The results clearly demonstrate the advantage of saltwater over freshwater injections for fire fighting and we provide a comprehensive set of petrophysical data to calibrate the numerical models and to describe the combustion process in total.

Key words: coalfire; fire fighting; saltwater; petrophysics; permeability; thermal conductivity; numerical modelling