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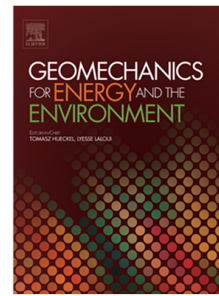
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1 **Applied stress reduces swelling of coal induced by adsorption of water**

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9 **Abstract**

10 This paper investigates whether or not applied stress reduces swelling of coal upon water adsorption,
11 and, if so, what mechanisms are responsible. With this aim, thermodynamic models were developed
12 addressing the effect of a general applied stress on water adsorption capacity and associated swelling
13 behaviour of coal matrix material, assuming monolayer, multilayer and mixed mono/multilayer adsorption
14 mechanisms. These all predict applied stress reduces water adsorption capacity and hence swelling.
15 Experiments were performed on both a solid disc and on pre-compacted powders of Brzeszcze high volatile
16 bituminous coal at a constant temperature (40°C), using a uniaxial compaction apparatus. The mechanical
17 response of the samples to stepwise axial loading was determined under both evacuated and water-exposed
18 conditions. The evacuated samples showed reversible, elastic behaviour. Water-exposed samples exhibited
19 elastic deformation, time-dependent reversible deformation, plus plastic strains with time-dependent
20 processes. Axial swelling strains upon introduction of distilled water at a constant fluid pressure (0.1 MPa)
21 were also measured for samples subjected to fixed axial stresses (25-100 MPa). The results demonstrated
22 the applied stress reduces swelling upon water adsorption. Comparison with predictions made using the
23 three models shows that stress-driven reduction in sorption-induced swelling is caused by the combined
24 effects of a) permanent time-dependent (compressive) deformation (creep), b) the thermodynamic effect of
25 a stress-driven reduction in water sorption capacity and c) stress-driven closure of transport paths within the
26 coal matrix. Nonetheless, our results show the above effects of stress on the swelling response of
27 (Brzeszcze) high volatile bituminous coal to water are minor at typical in-situ stresses (10-30 MPa). This

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