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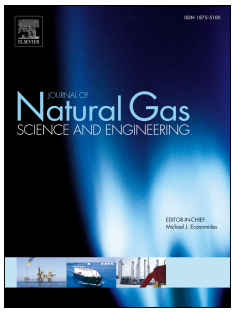


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# New insights into the permeability-increasing area of overlying coal seams disturbed by the mining of coal

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## Abstract

Many researchers have concluded that the permeability evolution of coal and rock is closely related to the stress change path. However, in the protective coal seam mining practices, the stress change path of the overlying coal seams is ignored, per the related technical criterion and regulations, the traditional permeability-increasing area in the overlying protected coal seam is generally delimited smaller than the mined-out area of the protective coal seam, which wastes a large quantity of coal resources. This study investigates the actual permeability-increasing area of the overlying protected coal seam through theories analysis, FLAC$^{3D}$ numerical simulation and field test. The permeability distribution of the overlying protected coal seam near the mined-out boundary in the strike direction (MBSD) is quantitatively divided into four zones, which are the original permeability zone, permeability decrease zone, permeability insufficient increase zone, and permeability sufficient increase zone. It is suggested that the actual permeability-increasing area is larger than the mined-out area of the protected coal seam. According the permeability distribution of the protected coal seam, optimized cross-measure boreholes were designs for gas drainage. The field tests showed that the outburst risk of the protected coal seam inside the MBSD was eliminated two months after the protective coal seam mining. The theories analysis, numerical simulation and field tests showed that the actual permeability-increasing area is larger than the traditional permeability-increasing area, the protected area in the protected coal seam can be enlarged by the optimized cross-measure boreholes gas drainage.

**Keywords:** stress change path; permeability; gas drainage; overlying coal seam