Research Advances

Study on the Fissure Rate in the Roof Strata of Excavated Coal Seams

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In the past decades, the intense excavation of coal resources in China has induced a series of severe water-related disasters or problems, such as water burst accidents, severe groundwater depletion and contamination. All of these problems were caused by the structural changes of roof rocks or bed rocks induced by coal excavation. The structure of collapsed roof rocks is generally classified into three zones: falling zone, cracking zone and bending and convergence zone, whose detailed distribution and structure vary between different mines and are less defined and quite difficult to investigate. Under the support of the State Key Program of National Natural Science of China (Grant No. 41130637), we selected a typical North China type coalfield of the Changzhi Basin in Shanxi Province as an example, and analyzed the changes of its roof aquifer structure caused by coal excavation through borehole observation, comprehensive geophysical investigation, physical modeling and numerical modeling. It is shown that the structural changes are different from the previous concepts, which can be used widely in North China type coal mines with the similar geological structure.

The changing process of roof aquifers during coal excavation is as following: along with the initial cut of working face, fissures developed in the falling zone A and border cracking zone B as illustrated in Fig. 1. As working face pushed forward, the cracked zone B was compacted into zone C. The outside of the zones A, B, and C is zone D with a slight structural change. The outside face of the zone D has drastically changed permeability coefficients across this face; we defined this face as a curved face with permeability abrupt change (CFPAC). Our field observations suggest that the permeability coefficient k in zones A and B is larger than 10^{-3} cm/s, while 10^{-4} cm/s < k < 10^{-3} cm/s in zone C, and $k < 10^{-4}$ cm/s in zone D.

These findings have provided significant support to the prevision of pit water burst and protection of groundwater resources in the Changzhi Basin of Shanxi Province.

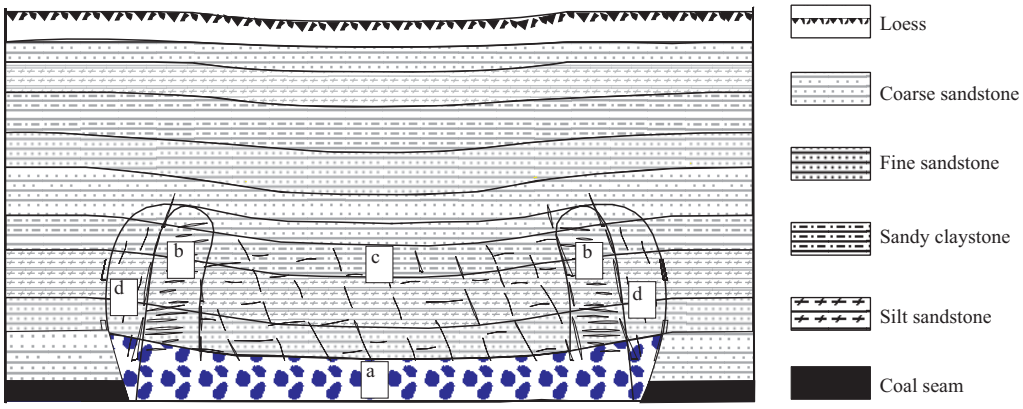

Fig. 1. Structural changes of roof aquifers caused by coal excavation in a type coalfield of North China.

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