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Modelling of height of connective fractures during longwall mining

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ABSTRACT

During longwall mining, the ability to reliably estimate the height of longwall mining-induced fractures is critically important in order to effectively manage mining-induced water inflows and aquifer interference. The extent of mining-induced subsurface deformation, fracture, surface subsidence and aquifer interference is largely controlled by local lithological conditions, mining methods and mine layouts. Therefore for the purpose of quantifying mining impacts it is imperative to incorporate the local geology and mine plan parameters in a mine scale model.

Two different numerical models based on 3D continuum (Finite Element Method) and 2D discrete (Discrete element method) domains, respectively, are developed to incorporate the mine site parameters of a study site in Australia. Both the models are calibrated and validated with measured mine data. The continuum numerical modelling method is used to investigate the change in permeability of the overburden strata due to underground extraction considering the full 3D nature of geology and mine layout. The discrete element modelling method is used to simulate the initiation and propagation of fractures, allowing the caving of overburden strata to be represented in a realistic manner, and the permeability enhancement of the strata overlying the goaf to be calculated from first principles. Permeability enhancement in the discrete element model is a direct function of the fractures induced in the deformation/caving process; fracture location, extent, aperture and connectedness.

From the numerical modelling under the simulated condition for the mine studied here, it is predicted that the permeability of the caving zone from the goaf to five times the mining height increases by almost six orders of magnitude. In the fracture zone to approximately ten times the mining height, the change in permeability is predicted to be around two to three orders of magnitude. At the height of more than ten times the mining height the magnitude of permeability increased is predicted to be one to two orders of magnitude.