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ABSTRACT: In this study, we investigate coal matrix swelling during the process of gas diffusion from cleats and its impact on the evolution of strain. We inject helium into both jacketed and unjacketed coal samples within a pressurized core holder. In the unjacketed experiment, the coal sample was exposed to hydrostatic gas pressure. In the jacketed experiment, the coal sample was constrained by fixed displacement at the two ends and by constant confining pressure laterally. In both experiments, strains were measured continuously both parallel/perpendicular to the bedding plane of the coal as internal pressure of helium is increased. For the unjacketed test the initial rapid compactive deformation of the sample rebounds to dilative at long term - attributed to the gas diffusion-induced swelling of the coal matrix. For the jacketed test both axial and circumferential coal strains are first dilative due to the decrease in effective stress with subsequent changes of coal strain induced by the gas diffusion closely associated with the specific boundary conditions. For a constant stress boundary, the circumferential strain first remains unchanged for some time and then gradually increases to steady state. Such a phenomenon suggests that when gas diffuses from the cleat to the matrix, the coal matrix-cleat system probably undergoes a transition from local swelling to macro swelling. In contrast, for a fixed displacement boundary, the axial strain first decreases and then reaches a steady state. It also indicates that the swelling of the matrix not only decreases the aperture of the fracture, but also expands the circumferential profile of the coal sample due to the Poisson effect. In addition, helium diffusion in the matrix is estimated by using the bidisperse diffusion model. The calculated effective diffusivity increases with pore pressure. This suggested that the gas diffusion coefficient is a pore pressure-dependent parameter. These results demonstrate that gas diffusion from the cleat to the matrix can cause the swelling of the coal matrix, change the aperture of the cleat, and in turn impact the evolution of the coal permeability.