UNITED RESEARCH FORUM
(CONNECT WITH RESEARCH WORLD)

4th International Congress on Earth and Geological Sciences

July 21-22, 2025 | Paris, France

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Mechanisms of surface disturbance induced by coal seam mining based on primary key strata analysis

Understanding the mechanisms of surface disturbances induced by coal seam mining is crucial for minimizing environmental impact and ensuring operational safety. This study explores the influence of coal seam extraction on surface deformation, focusing on the primary key strata (PKS) as a critical structural layer controlling subsurface and surface behavior. A theoretical calculation model is established to characterize the subsidence of the PKS, forming the basis for understanding its deformation under mining-induced stress redistribution. The study systematically evaluates the effects of key factors, including mining depth, coal seam thickness, PKS lithological properties, and overlying strata structure, on the distribution and magnitude of PKS subsidence. To enable quantitative assessment, a disturbance degree index is introduced, and a corresponding model is developed to evaluate mining-induced impacts on the PKS. Furthermore, a correlation model linking the disturbance degree to surface subsidence is constructed, enabling a comprehensive analysis of the coupling between subsurface deformation and surface responses. This research uncovers the combined impacts of geological and mining conditions on surface disturbance mechanisms. The findings provide a theoretical foundation for predicting and mitigating mining-induced surface subsidence. They offer practical guidance for optimizing mining strategies to balance resource extraction with environmental protection and operational safety.

Keywords: coal seam mining, primary key strata (PKS), surface subsidence, disturbance degree index, quantitative model

Biography

Nan Wang is a Ph.D. candidate at the China University of Mining and Technology (Beijing). From March 2024 to March 2025, she is a recipient of the National Public Study Abroad Scholarship, conducting research at the University of Lisbon in Portugal. Her research focuses on coal seam mining and intelligent ground control. She has published over 20 academic papers and has been awarded two provincial and ministerial level second prizes for scientific and technological progress.

ISBN: 978-1-917892-13-1

doi.org/10.51219/URForum.2025.Nan-Wang