**Project Title:** Numerical Modeling Methodologies for Assessing Burst Potential in Coal Mines

**Organization:** Colorado School of Mines

**Partnerships:** N/A

**Investigator(s):** Ugur Ozbay

**Focus Area:** Safety

## SYNOPSIS

***Problem Statement and Justification:*** Rock around underground mining excavations may fail in a gradual or sudden manner as stresses are increased due to progressive mining. Unstable failures are observed in both coal and hard rock mines and are commonly referred to as coal bumps and rockbursts, respectively. Large unstable failures come in the form of massive collapses or cascading pillar failures. Slips along large discontinuity planes may also take place. More localized forms of unstable failures may affect smaller areas of a mine or even isolated sections of a single pillar or sidewall. This proposal addresses such violent unstable failures in terms of assessing their potential for occurrence and their expected intensity in deep coal mines. The threat of dangerous coal bump events increases with depth and with higher levels of extraction. Additional factors, which are conducive to coal bumps, include strong roof and floor conditions, multiple seam mining, or existing faults and discontinuities in the surrounding rockmass. Numerical models provide additional tools with which to explore the underlying mechanistic causes of these failures as they relate to deep coal mines across the U.S. As part of this project, a series of coal bump case histories will be selected across a range of coal mining environments which will include violent compressional failure of support rock and unstable slip along large discontinuities. The bump hazard will be assessed through the total excess energy and local excess energy densities. The development of these methods is expected to support bump mitigation methods currently in use in deep coal mines to ultimately reduce the risk of injury to miners.

***Impact of the Research:*** The successful completion of this research would lead to a consistent methodology for assessing the threat of coal bumps through calculations of available excess energy using explicit numerical models. The measure of excess energy may then be applied with greater confidence to future studies of coal mines and deep mineral mining operations as a coal bump and rockburst mitigation method. Insight will additionally be gained on the mechanistic factors which contributed to each selected coal bump case history. A numerical methodology for assessing coal bumps and the knowledge gainedon each historical bump case may ultimately be applied to reduce the risk of injury to mine workers posed by dangerous coal bump events. The project will also produce qualified rock engineering personnel who can take positions at universities or in the mining industry which focus on mine safety.

***Objective and Research Approach:*** The objective of the project is to develop numerical modeling methodologies for assessing bump potential of a given coal mine setting. This objective will be achieved through backanalyses of previous coal bump events using numerical modeling methodologies, which we have recently developed as part of our research on improving the understanding of unstable failure mechanisms. Several historical cases of coal bump events that occurred in retreat, longwall, and room-and-pillar mines will be backanalysed using FLAC and UDEC codes in two- and three-dimensional models. Unstable compressive failures in the coal seam and slip along a pre-existing discontinuity will be explored. The research approach involves four specific tasks: i) establish and prepare about six to ten case studies that will be used for the backanalysis studies; ii) further develop the unstable failure modeling approach for mine-scale models; iii) develop numerical modeling methodologies for assessing excess energy availability in mine-scale models; and iv) develop modeling-based bump assessment procedures by testing and further developing the outcome of these tasks through backanalysis studies.