Preface

Over the past decades, great progress has been made in scientifically understanding rock failure behavior of rockburst. In particular, advances in field of monitoring and predicting methods of rock failure have led to a profound understanding of rockburst generation processes in terms of underlying physics. However, the world mining and geotechnical engineering scholars have done a lot of researches on the formation mechanism of rockburst, as well as its prediction, prevention, and so on. As the understanding of mechanism and criterion of rockburst just stays at hypothesis and test stage, the theory of rockburst prediction is far from perfect to guide the engineering work. Therefore, it is not appropriate to apply the existing theoretical results directly to solve the problems of rockburst.

This book focuses on investigating predicting precursory information and key points of rockburst through laboratory experiment, theoretical analysis, numerical simulation, and case studies. Understanding the evolution patterns for the microstructure instability of rock is a prerequisite to the rockburst predicting. The book aims at providing a guide for the readers seeking to understand the evolution patterns for the microstructure of rock failure, the predicting key point, and predicting model of rockburst. It will be an essential reference to the most promising innovative rockburst and even other dynamic hazard-predicting technologies.

The layout of monograph is as follows:

Chapter 1: A general introduction followed by an overview of rockburst. Also, the topic of study status on the occurrence conditions of rockburst and predicting means is discussed. What's more, it also gives some further study on predicting rockburst in this chapter.

Chapter 2: A detailed description of laboratory experiments and analytical approaches that have been adopted for the presented study is discussed in this chapter. It primarily contains scanning electron microscope (SEM) and energy spectrum analysis, acoustic emission (AE) experiment, and computed tomography (CT) scanning experiment of rock under loading. All experimental data are the foundation for the further discussion.

Chapter 3: A detailed introduction to rock failure theory and the occurrence mechanism of rockburst is discussed in this chapter. It includes the classical

rockburst mechanism, the stress-energy formation and occurrence mechanism of rockburst, the nonlinear dynamics theory on rockburst. All of the theories are the foundation to analyze the mechanism and the phenomenon of rockburst.

Chapter 4: Three-dimensional reconstruction model of fissures is presented in rock failure process. It shows the details of the rock cracks extraction and calculation based on the CT images, three-dimensional reconstruction model, and numerical simulation of rock fissures. In this chapter, detailed description of three-dimensional reconstruction model and numerical simulation of rock fissures is given.

Chapter 5: The process of destruction of geotechnical materials is the evolution of microcrack propagation. The complexity, polyphase, and disordered distribution of rock cracks constitute the nonlinearity of rock fracture instability. This chapter established rock system entropy model based on the nonlinear dynamics evolution patterns of crack using CT images, which effectively reveal the mesoscopic mechanisms from crack initiation to propagation. Then, it derives the crack growth factor model through the chaos of crack criterion. This chapter also reveals the pattern of rock damage evolution process of crack propagation.

Chapter 6: This chapter introduced the precursor information of failure of rock fracture, which includes the spatial and temporal evolution, the characteristics of relative quiet period, the energy change characteristics, and the spatial-temporal-energy evolution model of rock failure. Then, it also contains some microseismic events situation in deep mining. All of these information are the foundation of pre-characteristics of rockburst.

Chapter 7: This chapter mainly introduced the experimental investigation of synergetic predicting key points of rockburst using multi-measure monitoring, which includes some theories that had been used in monitoring and predicting rockburst, such as infrared thermography, load/unload energy response ratio theory, entropy theory, tangent damage factor (TDF) identification method, AE/microseismic activity monitoring theory, and so on. Based on all of these monitoring theories, we obtained the synergetic predicting model of rock failure using multi-measure monitoring methods.

Chapter 8: Bayesian theory, which has been successfully applied in many research fields, provides a clear and a flexible method for making predictions using incomplete knowledge. Fuzzy matter-element theory is primarily used to study the problem of incompatibility. It can be also used for solving multiple parameters evaluation problem by formalizing the problems and establishing the corresponding matter-element. In this chapter, we established rockburst predicting model based on Bayesian theory and fuzzy matter-element theory.

Chapter 9: Some cases were showed to analyze and verify the precursor characteristic of rockburst. It contains the experimental verification and on-site verification. In this chapter, we verified and analyzed the precursor characteristic patterns, the dynamics evolution, the predicting key point, and the predicting model of rockbursts by the microseismic monitoring system in Huize Lead–Zinc mine.

In this monograph, chapters are carefully developed to cover the evolution patterns for the microstructure instability of rock, and we established some

rockburst hazard monitoring, predicting criterions, and predicting models. The issue with a holistic and systematic approach addressed that predicting investigates of rockburst based on the evolution patterns for the microstructure of rock failure and establishes the predicting model of rockburst. This book is written for researchers of mining engineering, rock mechanics engineering, and safety engineering.

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