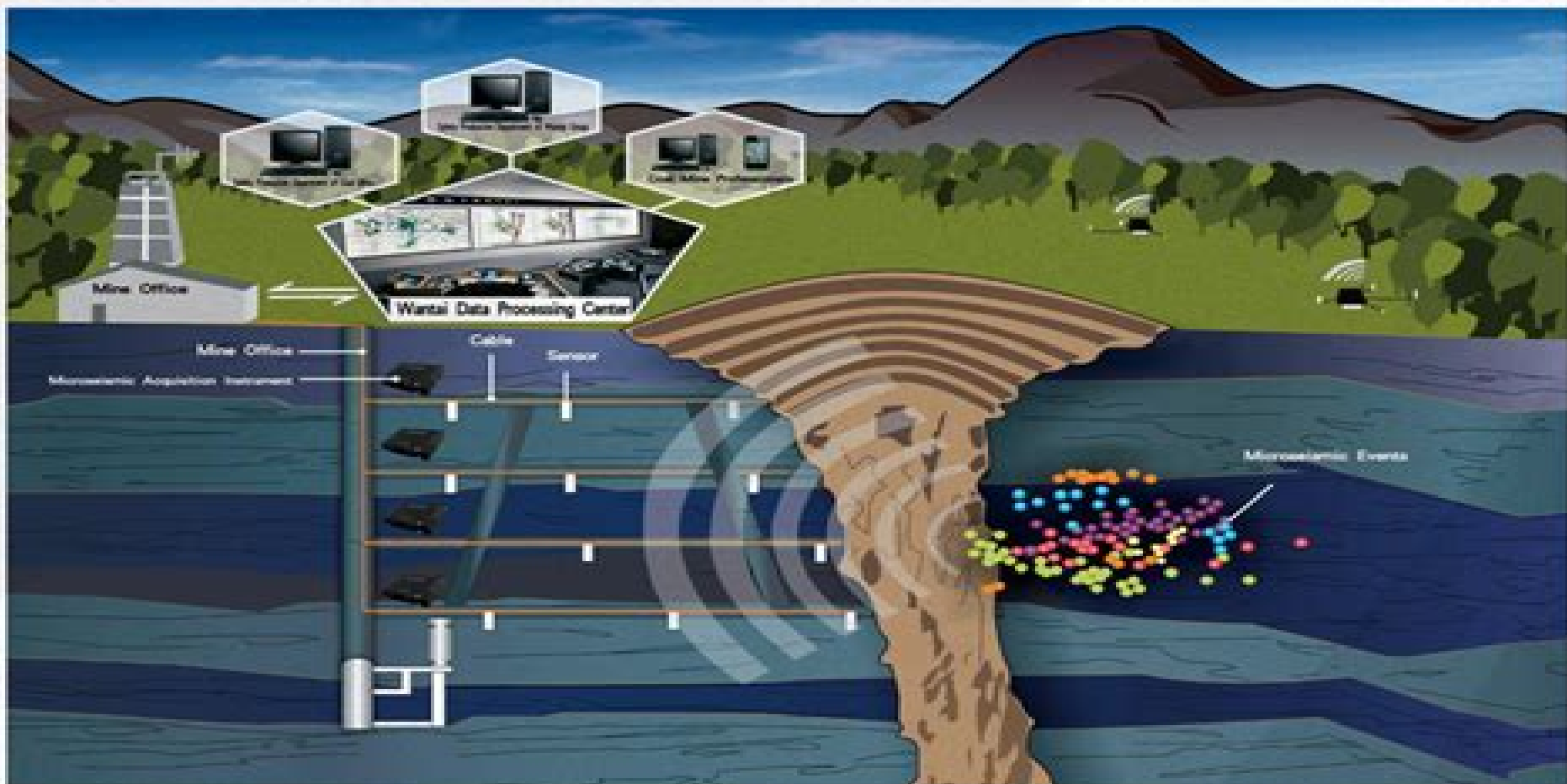




# Seismic Monitoring In Mines

**A.J. Mendecki**



## **Seismic Monitoring In Mines:**

*Seismic Monitoring in Mines* A.J. Mendecki, 1996-12-31 Routine seismic monitoring in mines was introduced over 30 years ago with two main objectives in mind immediate location of larger seismic events to guide rescue operations prediction of large rockmass instabilities The first objective was achieved fairly quickly but with the subsequent development of mine communication systems its strategic importance has diminished The very limited success with prediction can at least partially be attributed to three factors seismic monitoring systems based on analogue technology that provided noisy and frequently poorly calibrated data of limited dynamic range the non quantitative description of a seismic event by at best its local magnitude and the resultant non quantitative analysis of seismicity frequently through parameters of some statistical distributions with a somewhat loose but imaginative physical interpretation The introduction of modern digital seismic systems to mines and progress in the theory and methods of quantitative seismology have enabled the implementation of realtime seismic monitoring as a management tool quantifying rockmass response to mining and achieving the first tangible results with prediction A seismic event being a sudden inelastic deformation within the rockmass can now routinely be quantified in terms of seismic moment its tensor and radiated seismic energy so that the overall size of and stress released at the seismic source can be estimated

*Seismic Monitoring in Mines* A.J. Mendecki, 2012-12-06 Routine seismic monitoring in mines was introduced over 30 years ago with two main objectives in mind immediate location of larger seismic events to guide rescue operations prediction of large rockmass instabilities The first objective was achieved fairly quickly but with the subsequent development of mine communication systems its strategic importance has diminished The very limited success with prediction can at least partially be attributed to three factors seismic monitoring systems based on analogue technology that provided noisy and frequently poorly calibrated data of limited dynamic range the non quantitative description of a seismic event by at best its local magnitude and the resultant non quantitative analysis of seismicity frequently through parameters of some statistical distributions with a somewhat loose but imaginative physical interpretation The introduction of modern digital seismic systems to mines and progress in the theory and methods of quantitative seismology have enabled the implementation of realtime seismic monitoring as a management tool quantifying rockmass response to mining and achieving the first tangible results with prediction A seismic event being a sudden inelastic deformation within the rockmass can now routinely be quantified in terms of seismic moment its tensor and radiated seismic energy so that the overall size of and stress released at the seismic source can be estimated

**Elements of Seismic Hazard in Mines** Aleksander J. Mendecki, 2025-09-30 The main and first objective of this well illustrated open access book is to introduce define and explain common terms and concepts in earthquake and mine seismology In seismology diverse fields ranging from mathematics classical mechanics geology rock and fracture mechanics to statistical physics with their specific jargon and terminology are brought together Therefore the language of earthquake and mine seismologists includes terms which may not be familiar to

many geotechnical and mining engineers For example the proliferation of different earthquake magnitude scales has caused confusion about even this presumably simple concept and statistical physics brought in a plethora of new terms into the seismological parlance The second aim of this volume is to clarify some of the misconceptions in particular related to the analysis and interpretation of mining related seismicity and to seismic hazard assessment for mines As third aim the book stresses the need for testing the quality and integrity of the data before any analysis and assessment is attempted the importance of quantifying observations and estimating the associated uncertainties This book is primarily intended for mine seismologists and for mine geotechnical engineers who are or plan to become involved in advising mining companies on how to manage the seismic rock mass response to mining The book will also be of interest to mining and geotechnical engineering students

*Seismicity in Mines* G. Gibowicz, 2012-12-06 Recent seismological research has focused on processes other than pure shear failure double couple as an alternative mechanism for some types of seismic events This has been stimulated by what appears to be anomalous focal mechanisms observed for several earthquakes of possible volcanic nature in the 1980 Mammoth Lakes California sequence JULIAN and SIPKIN 1985 SIPKIN 1986 Although studies have concentrated on earthquakes associated with magmatic processes possible non double couple seismic failure has been observed but not widely known in cases of mine seismicity in the past three decades Such cases have occurred on a world wide basis however no cases until now have been observed in the United States The existence of non double couple failure in mine seismicity has been controversial as it has been for tectonic volcanic earthquakes Several of the benchmark studies of mine seismicity in the deep South African gold mines have resulted in the belief that no fundamental distinction in the source mechanism exists between tectonic earthquakes and rock bursts MCGARR 1984 both types of events are the result of pure shear failure However the reported cases of implanational focal mechanisms for mine seismicity continue to increase in number and prolong the controversy During the summer of 1984 a three dimensional high resolution micro earthquake network was operated by Woodward Clyde Consultants WCC in the vicinity of two coal mines beneath Gentry Mountain in the eastern Wasatch Plateau of central Utah

Mine Seismology: Seismic Warning Concept S.N. Glazer, 2017-10-03 This book illustrates how mine seismology can be used to improve underground safety standards It describes several preventive actions that have been put into practice at the 5B Area of No 5 Shaft Vaal Reefs gold mine after issuing seismic warnings These included additional safety pillars changes in mining sequences and directions and a review of the mining strategy for the entire 5B area The presented experiment with seismic warning concept was a success because it was an internal mine project Further the Vaal Reefs management adopted the philosophy that the success rate should be measured in the preventive actions taken not in the success of the prediction itself Reviewing these and other aspects the book clearly demonstrates how mine seismology can effectively improve underground safety standards Stefan Glazer's book addresses in a very comprehensive manner both technical and practical problems of implementing and then effectively using microseismic

networks and data Stefan proves that through comprehensive microseismic data analysis the location of potential rock burst can be assessed and then prevention action plans can be developed providing more confidence to management and workers that deposits can be mined safely Michal Stawski VP Strategic Geomechanical Specialist PT Freeport Indonesia I began reading this story expecting to find a technical review of the science of seismology and its application in mining but this book is much more than that This is a must read for those managing seismically active mines and should provide a wake up call to the industry as the complex morality surrounding the management of seismic risk needs to be clarified in order for this to advance Eric Strom Director Underground Mining New Gold Inc As a mining geotechnical practitioner having experience in large open pit and underground massive mining operations I have learned that mining induced seismicity can have a significant impact on the safety and economics of operations However seismicity is a complex field that is generally left to specialists with little input from geotechnical engineers and engineering geologists This is a must read for mine seismologists geotechnical practitioners and mining engineers alike and will be a welcome and much needed addition to my own book cabinet This will be an invaluable work as our industry progresses to the mining of new depths in both the underground and open pit environments Desmond Mossop Pr Sci Nat Principal Engineering Geologist SRK Consulting

**Mine Seismology: Data Analysis and Interpretation** S.N. Glazer, 2016-04-27 This book offers an in depth analysis and interpretation methods applicable to mine induced seismicity It is based on over 40 years of experience in mine and exploration geophysics Another unique feature of this book is the complete history of the caving process as evidenced by the recorded seismicity at the South African copper mine Palabora Lift 1 Until now the literature has only presented theory and case studies discussing the interpretation of results and there has been no discussion of the input data quality or why a certain interpretation technique was applied This book fills that gap This book is a fascinating read written by one of the world's leading mine seismologists It summarises the history and progression of mine seismology It outlines the practical use of back analysis of data and how it can be used on a daily basis The book explains how mine seismology can be used as an effective monitoring tool for key events as the mine progresses as well as for future caving operations Anthony Allman MAusIMM CP Min RPEQ Antcia Consulting Pty Ltd Director Mining Engineer The content of the book is really solid and robust and I have no doubt it is going to be considered a great contribution for the mining community Raul Fuentes Former Director of Master Program in Geomechanics Applied to Mining Universidad de los Andes Santiago Chile This book is long overdue and helps to present some difficult concepts in a way that they can be clearly understood by non experts in this area Stefan has personally managed to take mine seismology from being a black art into a useful tool to help make mines a safer and more controlled environment Neil Hepworth C Eng MIMMM Geomin Consultorio Brazil Consultant Mining and Geotechnics Seismic monitoring is an important tool in cave management The information from monitoring allows a number of key production factors to be determined including cave advance rates the approximate location of the cave back insight into the size of the

air gap and allows the tracking of broad changes in stress These all assist in the day to day management of a safe and successful cave Dr Glazer s book provides guidance on the application of microseismicity to cave management through a review of appropriate theory and more importantly illustrates its use through case histories particularly from the Palabora block cave The text will be a good addition for all practitioners in cave engineering and operations Allan Moss General Manager Grasberg Underground Liaison Copper Development Rio Tinto

**Passive Seismic Monitoring of Induced Seismicity** David W. Eaton,2018-04-26 The past few decades have witnessed remarkable growth in the application of passive seismic monitoring to address a range of problems in geoscience and engineering from large scale tectonic studies to environmental investigations Passive seismic methods are increasingly being used for surveillance of massive multi stage hydraulic fracturing and development of enhanced geothermal systems The theoretical framework and techniques used in this emerging area draw on various established fields such as earthquake seismology exploration geophysics and rock mechanics Based on university and industry courses developed by the author this book reviews all the relevant research and technology to provide an introduction to the principles and applications of passive seismic monitoring It integrates up to date case studies and interactive online exercises making it a comprehensive and accessible resource for advanced students and researchers in geophysics and engineering as well as industry practitioners

An Introduction to Mining Seismology Slawomir Jerzy Gibowicz, Andrzej Kijko,2013-10-22 An Introduction to Mining Seismology describes comprehensively the modern methods and techniques used to monitor and study seismicity and rockbursts in mines Key case histories from various worldwide mining districts clearly illustrate and skillfully emphasize the practical aspects of mining seismology This text is intended as a handbook for geophysicists and mining and rock mechanics engineers working at mines It will also serve as an essential reference tool for seismologists working at research institutions on local seismicity not necessarily induced by mining Presents a comprehensive description of seismicity induced by mining worldwide Provides information on optimum network planning and seismic event location procedures in deep mines Covers a broad array of topics including focal mechanism moment tensor and double couple versus non double couple seismic events in mines Includes data on source parameters and scaling relations for seismic events in mines

**Monitoring a Comprehensive Test Ban Treaty** Eystein S. Husebye,Anton M. Dainty,2012-12-06 An international treaty banning the testing of any nuclear device in any environment a comprehensive test ban treaty CTBT has been on the political agenda for nearly 40 years Objections to a CTBT have been political technical or a combination of both However the possibilities seem better after the end of the Cold War In the prevailing cooperative disarmament climate a CTBT appears likely to be approved by most countries in 1996 Hence the great current interest in monitoring technologies and capabilities Such issues are comprehensively addressed here a preamble being devoted to the political developments and setbacks over the past 40 years Since seismic means are considered the dominant monitoring element they are explored in detail Contributions cover network deployments advanced signal

processing wave propagation in heterogeneous media and seismic source representations and a variety of techniques for source classification including neural networks Complementary monitoring techniques such as hydroacoustics radionuclides and infrasound are also summarised The IAEA operation for monitoring compliance with the Non Proliferation Treaty is also presented The book also includes eyewitness accounts of the Soviet 50 Mt megabomb development and test as well as the efforts made by the state to monitor the nuclear test programmes of the western powers Includes some 33 articles written by distinguished scientists active in CTBT monitoring research for decades

**Seismicity Associated with Mines, Reservoirs and Fluid Injections** Shahrian Talebi, 2012-12-06 This volume contains 18 papers from 8 countries dealing with different aspects of triggered and induced seismicity In situ observations of the phenomenon include examples of seismicity due to reservoirs hard rock mines coal mines mine collapses brine production caverns fluid injections and geothermal hot dry rock projects High frequency acoustic emission studies from laboratory experiments and hard rock mines have also been reported Besides providing case studies of previously unavailable observations of seismicity the present volume contains investigations of the causes and source mechanism of seismic events determination of source parameters seismic hazard as related to the design of support systems for underground openings and procedures for closure of brine production caverns and the use of seismic and non destructive techniques in assessing rock damage measuring dynamic elastic moduli and detecting discontinuities This collection of papers provides an excellent indication of the state of the art recent developments and outstanding challenges facing scientists and engineers in understanding the causes and alleviating the effects of induced seismicity

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