（第二版）

黄金矿山地质学

张宝仁　黄绍锋　等著

地质出版社

黄金矿山地质学

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·北　京·

内 容 提 要

本书是在第一版的基础上，进一步阐述矿产资源开发程序，矿山地质学的概念、意义；叙述了矿山开发各阶段地质工作及专门性地质工作；论述了金矿的基础地质理论；岩金矿地质勘查、评价和成矿预测；重点修订了矿山地质及地质勘查中一些重要研究方面和地质技术工作方法，充实了砂金矿山地质和岩金矿床类型。

本书内容详实、丰富，系统论述了矿山地质学的理论体系和范畴。本书可作为高等院校矿山地质专业、矿产地质勘查专业教学用书，也为地质勘查、矿山设计和科研工作者提供一部有价值的参考用书，为广大矿山地质人员和管理人员提供了一部工具书。

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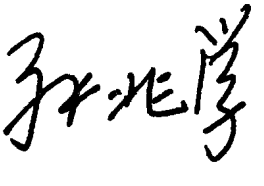
再版序言

《黄金矿山地质学》一书自1997年出版发行以来已历时14年了。10多年来，该书被黄金行业工作者广泛应用于矿山生产、地质找矿与勘查以及科研和教学工作中。

当前，我国的矿业政策和资源形势与10多年前相比，发生了巨大变化。首先是我国经济的快速发展对矿产资源的需求不断增加，而国内矿业企业的国际化进程也要求我国矿业生产、技术和经营管理积极适应国际准则与规范。其次，我国矿产资源勘查和开发体制、投资主体等发生了很大变化；地质勘查技术与方法，金矿选冶技术也取得了显著进步，矿山地质工作不再局限于为矿山生产开采服务，而是逐渐演变为确保矿山持续稳定生产，指导矿山深部及外围的地质探矿，乃至新区的地质找矿与矿权运作服务。尤其重要的是，作为经济范畴的矿产资源，其经济价值是随着技术经济条件的变化而不断变化的。因此，矿山地质工作者还肩负着在矿山生产期间对地质资源进行实时评价的重任。

为适应上述矿业经济与技术变革，本书作者对《黄金矿山地质学》一书进行了全面修订。本次修订除增加了矿床新类型和对一些章节进行修改完善外，重点是结合国家新颁布的金矿勘查规范，对第二篇岩金矿（床）勘查概论，以及黄金矿山的发展进行了补充和修改。同时新著《黄金矿山地质资源经济评价》作为本书的续篇。本次修订再版是在新的矿业经济形势下，对黄金矿山地质学内容与方法的补充和完善，为广大矿山地质工作者和找矿科研人员、大专院校师生提供了一部实用的工具书和专业教材，同时也全面地回答了在市场经济条件下如何开展地质找矿及资源评价，以及矿山资源的合理有效开发利用问题。这不仅对黄金矿山和其他金属矿山地质资源的有效开发和合理利用，以及矿山地质工作的发展都将起到积极的促进作用，而且将在推动我国黄金工业走资源节约和可持续发展的道路上做出应有的贡献。

中国黄金协会会长
中国黄金集团公司总经理 

2010年3月

PREFACE TO SECOND EDITION

It has been fourteen years since *The Geology of Gold Mines* was published in 1997. During the past ten years, the book has been widely used for mining production, ore prospecting and exploration as well as scientific research and teaching by the gold industry workers.

Compared to ten years ago, China's mining policy and resource situation has now changed dramatically. Firstly, the rapid economic development of the country requires an increasing number of mineral resources, and the internationalization process of the domestic mining enterprises also demands the production, technology, operation and management of our country' s mining industry to actively meet the international standards and norms. Secondly, the exploration and development system of the country's mineral resources and main investors have had great changes with significant progress in the field of geological prospecting technology and methods as well as mineral dressing and metallurgy technology. Mine geology, which no longer confined to the mining production services, is gradually evolved to serve for ensuring constant and steady production of mines, guiding the ore prospecting in depth and outside mines and prospecting in new areas with the service of mining right there. More importantly, the economical value of mineral resources in terms of economical category varies with the changes of technological and economical conditions. Therefore, mining geologists also shoulder the responsibility of constantly evaluating the geological resources during mining production period.

In order to meet the above changes of economy and technology in mineral industry, the authors have made a comprehensive revision of *The Geology of Gold Mines*. This revision, which combined with the state newly issued regulations on gold mines exploration, underlines the supplements and modification on the generality of rock gold deposits exploration in chapter two and the development of gold mines. It also adds chapter on new type of ore deposits and improves some chapters. Meanwhile, the book takes a chapter titled *The Economical Evaluation of Geological Resources of Gold Mines* as its continuation. Under new situation of mineral economy, the revision newly supplies and improves some contents and methods of gold mine geology. It is a practical reference book and a specialized textbook for mineral and geological workers, prospecting scientific researchers, and college teachers and students, in addition, it gives a overall reply of the problems which concern about how to carry out geological prospecting and resources evaluation in marketing economy, as well as the reasonable and effective development and utilization of mineral resources. Therefore it not only actively promotes the effective development and reasonable utilization of geological resources of gold and other mental mines and facilitates the development of mineral and geological work, but also makes contribution to push our gold industry to way of resources – saving and sustainable development.

Chairman of Chinese Gold Association
President of Chinese Gold Group Company
Sun Zhaoxue

March, 2010

再版前言

目前，我国矿业的发展和矿产资源勘查、资源开发形势发生了重大变化。为适应市场经济的需要，贯彻《固体矿产资源/储量分类》（GB/T17766－1999）、《固体矿产地质勘查规范总则》（GB/T13908－2002）和岩金、砂矿（金属矿）等部分矿种的规范，以规范为准则和指南，并吸收和采纳了广大矿山地质工作者的建议，作者对全书进行了全面系统的修订，增加了新的内容，分两册出版。一册为原版部分，重点修订了岩金矿（床）地质勘查有关章节，充实了矿床地质和矿体地质研究、开采技术条件和可行性研究、强调了地质勘查方法和地质工作技术方法，对部分章节进行了充实、调整、归并。另一册为新著的《黄金矿山地质资源经济评价》。矿产资源的经济价值，随着技术条件的变化而变化。为此，矿山地质工作肩负着时时评价的重任，以充分合理利用矿产资源和使经济效益最大化。本册提供了地质资源经济评价的新内容、新方法，使书的内容更加完整、充实和系统。

本书再版的修订编写工作，得到了中国黄金集团公司有关部门和同行的大力支持、鼓励和帮助，得到了河南金源黄金矿业有限责任公司、嵩县前河矿业有限责任公司、嵩县金牛有限责任公司以及潼关中金黄金矿业有限责任公司的领导及其所在单位的大力支持，得以顺利完成。中国地质大学龚庆杰博士及研究生们为本书原版制作电子版及金源公司地测部的周娟、付彩云等同志对电子版进行了校对。在此一并表示衷心感谢。

本书再版修订过程中，在中金黄金矿业有限责任公司北戴河矿山地质培训班和黄金矿山企业进行了讲授，收到了很好效果。承蒙地质出版社祁向雷编辑的大力支持和帮助。中国黄金协会会长、中国黄金集团公司总经理孙兆学，在百忙中特为本书再版作序。谨一并表示敬意和谢忱。

本书再版修订过程中，引证和参考了国内外有关专著、文献和资料。未正式出版的参考资料，书中均未列入，恳请谅解。谨向与本书资料来源有关的单位和编辑著者，致以诚挚的谢意。

由于作者水平有限，书中错误、疏漏之处在所难免，敬请广大读者批评指正。

著　者

2010年3月18日

FOREWORD TO SECOND EDITION

Now the development of mining industry and the prospecting and exploration of mineral resources in China have changed dramatically. In order to meet the requirement of marketing economy and carry out the *Classification of solid mineral resources/reserve* (GB/T17766 - 1999), *General rules to geological exploration of solid mineral resources* (GB/T13908 - 2002) and rules of some mineral category such as primary gold , placer (metal mineral) etc. taking the rules as principles and guidelines, and assimilating and adopting suggestions of mining geologists, the authors made a overall and systematic revision to the whole book and added some new contents. The book is going to be published in two volumes. One is the original edition in which we mainly revised the characters related to the geological exploration of primary gold with enriching the research of mineral geology and ore geology, mining conditions and its feasibility, emphasizing the method of geologic exploration and working technique, completed, regulated and classified several characters. The other volume is new *Economic evaluation of geological resources of gold mines*. The economic value of mineral resources varies as technical conditions change. So the mining geologists should take the responsibility to make evaluation all the time, to make full use of mineral resources reasonably and maximize the economic value. The volume provides new content and method of economic evaluation of geological resources to make the book more complete, substantial and systematic.

The fulfillment of the second edition of the book should owe to the support, encouragement and help from the related departments and peers of Chinese Gold Group Corporation, the leaders and departments of Henan Jinyuan Gold Mining Co. Ltd, Songxian Qianhe Mining Co. Ltd. 、 Songxian Jinniu Co. Ltd. . Zhou Juan, Fu Caiyun etc. from Geologic Survey Department revised the reprint of the book. Thanks sincerely here.

In the process of revising the manuscript, we gave lectures to the Beidaihe mineral and geological training class of Zhongjin Gold Mines Co. Ltd as well as gold mines enterprises with a good reaction. I would like to extend my honor and sincere thanks to the support and help from Qi Xianglei, the editor of Geological Publishing House, as well as the preface by Sun Zhaoxue, the chairman of Chinese Gold Association and the general manager of Chinese Gold Group Company, taking off time from his busy schedule.

During the revision of the book' s second edition, we have citied and referred to monographs, literature and information from home and abroad. References which were not officially published were not listed in the book. We sincerely hope for understanding and would like to extend our heartfelt thanks to departments concerned and editors.

In addition, we look forward to your criticism and correction.

The authors
March, 2010

序　言

《黄金矿山地质学》一书问世了，这无论对金矿地质界、矿山地质界和开采加工部门都是一件好事。

本书作者从事矿山地质工作已达30余年，对矿山地质有着理所当然的深刻的认识与体会。这首先表现在，经过长期实践，作者拓宽了矿山地质的领域与思路，即除了将矿山地质着眼于矿山生产过程地质工作的传统认识外，将矿山建设前期可行性研究阶段的地质工作、矿山开采设计中的地质工作、矿山基建阶段的地质工作，以及矿山闭坑总结中的地质工作等也囊括于矿山地质学的领域内。应当说，上述不同阶段的地质工作都与传统的、经典的矿山地质息息相关，它们共同形成密切有机联系的整体。

矿床的勘探报告无疑十分重要，它是进行矿山建设及开发的必需基础资料。但也必须承认，勘探报告立足于较多的“一孔之见”，不可能对矿床求得较全面而又深刻的认识。矿山的设计开采生产过程为对矿床的深化理解提供了可能和条件。因此，提高地质工作的精度，进行尽可能的储量升级，并进而指导开采生产工作便是矿山地质人员的光荣职责。为此，在勘探报告的基础上，矿山地质工作者还必须进行大量工作，对各种控矿构造、矿石组成、开采条件、技术经济评价等进行细致的观察、剖析、综合。这不仅是矿山合理开发所必需的，而且也对矿床学理论水平的提高有促进作用。正因为矿山地质对生产与理论的双重重要性，在1994年9月由加拿大地质学会主持，召开了专门的世界级或超大型矿床勘查及矿山地质讨论会。

本书的另一特点，是除了矿山地质理论与方法外，还以很大篇幅阐述了矿山地质管理工作。由于作者有多年的地质管理经验，管理与地质的结合便显得很自然、合理、协调。

书中的另一重要特点，是一般性的矿山地质工作与专门性地质工作的结合，后者包括诸如矿山水文地质、矿山环境地质、矿山地质经济等。如果缺少这些专门性研究，矿山地质便是不完备的，难于完成赋予它的任务。在这方面作者的亲身实践与体会为本书增加了分量。

本书还列举了我国21个岩金矿山实例，介绍了它们的地质、开采方式、选冶

工艺、生产与技术经济指标等。这就使得本书的内容更为完整与齐备了。

相信本书的出版将为从事、参与及关心固体矿产矿山地质的同志提供一份有新意的参考材料。

涂光炽

1997 年 1 月

PREFACE

The publication of Gold Mining Geology would be beneficial to personnel engaged either in the field of gold mining geology, or in the field of mining and processing.

The authors have profound understanding of mining geology owing to their more than 30 years' experiences in this field. This is mainly proved by the fact that they have broadened the scope and knowledge of mining geology through their long-term work. In addition to the conventional geological work at the mining production stage, the geological work at such periodical stages as the feasibility study in pre-construction stage, the mining design stage, the capital construction stage and mine closing stage is combined in the scope of mining geology. The above- mentioned geological work at different stages is closely related to conventional mining geology, both of which jointly make up an integrated unity.

The deposit exploration reports are undoubtedly very important, as the date in the reports are fundamental and necessary for mine construction and development. However, it is admitted that the data obtained in the reports are based only on the results of a limited number of boreholes and one hardly obtains comprehensive and profound knowledge of mine deposit from these reports. The process of mine design, mining, and production makes one possible to have a deep understanding of deposits. Therefore, improving the precision of geological work, upgrading the reserves and then giving guidance for mining work are the mining geologists' glorious duty. For this reason, mining geologists should carry out a lot of work to observe, analyse and summarize various ore-control structures, ore composition, mining conditions and mine economics on the basis of exploration report which is not only essential for rational mining development, but enhances the level of geology of ore deposits. Because of the importance of mining geoglogy in mining production and theory, the Symposium on Prospecting and Mining Geology for World Scale or Super-large Sized Deposits was sponsored by the Canadian Geological Society in September, 1994.

Another feature of this book lies in that mining geological management is discussed in large parts in addition to mining geological theories and methods. The authors combine the management with geology in a natural, rational and harmonic way as a result of their many years' experiences in geological management.

The authors also combine the ordinary mining geological work with professional geological work in the book. The latter comprises mining hydrogeology, mining environmental geology, mining geological economics, etc. Without these professional researches, mining geology would be imperfect and also impossible to fulfil its own assignments. It is the authors' experience and knowledge in this area that enrich the contents of this book.

21 cases of hard rock gold mines are included in this book, and their geology, mining, metallurgy, production and techno-economical indexes in these cases, etc. are introduced, making contents of this book be more perfect and complete.

I believe that the publication of this book will provide a lot of new information for the people who are engaged in or concerned about mining geology in solid mineral resources.

Tu Guangchi

Jan. 1997

前　言

随着我国黄金工业的发展，黄金矿山也得到了迅猛的发展，近二三十年来大小黄金矿山相继在全国各地建立起来。随着黄金矿山现代化建设，黄金矿山地质工作也取得了显著成绩。矿山地质已成为黄金矿山开发必不可少的组成部分。矿山地质的概念、任务、范围和作用，以及它的重要性，越来越广泛、深入地为地质界、矿业界的人士所认识。

本书是作者三十余年从事黄金矿山地质找矿、勘探、评价、生产、管理、设计、科研、教学等实践经验的总结；旨在根据黄金矿业开发的需要，为黄金矿山生产服务，提高黄金矿山地质工作水准，促进矿山地质的发展。本书阐明了矿产资源开发程序，论述了矿山地质学的概念、意义；叙述了岩金矿山各阶段的矿山地质工作任务、内容和方法，岩金矿山开展的专门性地质工作，岩金矿山地质勘探、评价和成矿预测，岩金矿山地质经济问题和矿山开发中一些重要技术工作方法，并对砂金矿山地质作了简要介绍。书中还附录我国21个典型岩金矿山实例（每个实例包括矿床地质、矿山地质、矿山开采方式、选矿工艺和矿山生产及主要技术经济指标）。全书共四篇十四章，由编著者分工撰写后张宝仁统编成稿，寸珪审阅全稿，书中英文由袁海军翻译。

本书的编写工作得以顺利完成，得到了编著者所在单位的领导和同志们的大力支持和帮助；冶金部黄金局崔德文副局长，地矿办张泽钦、韩冰、宋玉国高级工程师为本书初稿提出了十分有益的建议；沈阳黄金学院及地质系领导大力支持；学生张云蜂、兰启堂、鲍明学、姜文峰、陈刚、王起春、刘峰、张冬、衡振平和地本4班、5班、矿地10班、11班的同学帮助誊稿及描图；武警黄金10支队杨秀庆先生、山东省蚕庄金矿邵生南矿长、界河金矿贾玉辉矿长以及河西金矿邵仕琪矿长等资助本书的出版，在此一并表示衷心的感谢。

本书在编写过程中，引证和参考了国内外有关专著、文献及我国黄金矿山（矿床）的大量地质资料；但未正式出版的参考资料，在书中均未列入，恳请谅解。谨向与本书资料来源有关的单位和参考文献的编著者，致以诚挚的谢意。

本书几经修改，已在沈阳黄金学院讲授三轮，收到很好的效果。承蒙中国建材

工业出版社赵从旭编审的鼎力支持和帮助；中国科学院院士、地学部主任、著名地质学家涂光炽教授在百忙中特为本书作序，谨一并表示敬意和谢忱。

由于编著者水平有限，书中错误、疏漏在所难免，敬请广大读者批评指正。

著　者

1997 年 1 月

FOREWORD

Gold mines have made rapid progress with the development of gold mining industry in China. Large-and small-scale gold mines were set up in succession throughout the country for the last 20 to 30 years. Owing to modernization of gold mines, outstanding achievements have been obtained in gold mining geology which is a necessary constituent part of gold exploitation. The concept, task, scope, role and importance of mining geology have been realized more and more extensively and thoroughly by people in geological and mining circles.

This book sums up the authors' experience of over than 30 years in geologic prospecting, evaluation, production and management and design, research and teaching related gold mining, aiming at serving gold production and enhancing the level of gold mining geologic work as well as promoting the development of mining geology. It involves the procedures of mineral resources exploitation, the concept and significance of mining geology, the tasks, scopes and methods of mining geology at each stage of gold mining, the specific geological work for hard rock gold mines geological prospecting, evaluation and metallogenic prognosis relaled to hard rock gold mines, hard rock gold mining, geological economy, some techniques and methods during mining development and a brief introduction to placer gold mining geology as well, with examples of 21 hard rock gold mines in China, each of which contains geology of ore deposits, mining geology, stoping methods, metallurgy, operation and some main technical and economic indexes of the gold mines. This book consists of 4 parts and 14 chapters which were completed by the authors individually and assembled by Mr. Zhang Baoren. Ms. Cun Gui reviewed manuscripts. The English translation is made by Mr. Yuan Haijun.

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Comments on this book are warmly welcome.

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