

MINERAL
DEPOSIT
MODELS
OF CHINA

中国矿床模式

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地质出版社

序

由地质矿产部矿床地质研究所等 28 个单位的矿床地质学家、教授及生产第一线的矿产地质勘查专家共同编写，著名矿床地质学家裴荣富研究员担任主编的《中国矿床模式》问世了。全书编入了除天津、上海之外的 28 个省、市、自治区的 45 个主要固体矿种的 92 个矿床模式。这是我国固体矿产领域地质勘查实践经验的总结和理论研究成果的大荟萃，集中反映了中国矿床学的最新进展。

我国除西部未开发地区外，露头矿愈来愈少，找矿难度越来越大，预测与寻找隐伏矿特别是预测和寻找大型、超大型隐伏矿的重任已摆在地球科学家面前。《中国矿床模式》的出版在客观上适应了这一发展的需要。它将在理论上和实践上帮助广大矿产勘查人员识别各类矿床模式，了解和对比它们产出的构造背景、成矿环境及矿床地质特征，并应用这些模式有效地发现和评价新的矿床，就矿找矿，由已知矿床找隐伏矿床。这正是“中国矿床模式”出版目的之一。

矿床模式 (Mineral Deposit Models) 是一类矿床模式化的标准样式。它总结于实践经验，但高于实践经验。也就是讲，它是全面高度地概括一类矿床的综合表征，并以写实为主，推断解释为辅的描述性模式。它具有以地质观察研究为基础的科学性和一定理论认识的概念性相结合的特点。特别是该书提出了一个适合中国地质构造背景和成矿环境的“中国矿床模式”分类；在中国 4 大构造背景和 27 种成矿环境中配置出 92 个矿床模式，使每一类矿床都在一定的构造背景下和一定的成矿环境中模式化。它不仅将矿床模式依托在一定的构造背景和成矿环境中，而且在一定构造背景和成矿环境中进行地质勘查时更易于找到相应的矿床。这样使矿床模式既见“树”又见“林”，充分发挥其在地质勘查中的重要指导作用。这是该书密切结合中国矿床地质特征而编写的特点，是对当代已出版的类似矿床模式书籍的重要发展，也是中国矿床地质研究征途中的一个新里程碑。另外，书中还编入了与矿床评价有关的矿床规模、矿床标型矿物特征、矿床稀土元素特征值、流体包裹体特征和稳定同位素研究方面的附录，对矿产勘查也具有参考对比价值。

《中国矿床模式》的出版，不仅有重要的科学价值，而且具有重要的认识论意义。它是运用唯物辩证法指导矿床学研究的范例。矿床模式的建立，生动地反映了人们在认识矿床方面从感性到理性，从个别到一般，从实践到理论再到实践的认识运动过程。用已建立的矿床模式来指导找矿，又是找矿哲学中类比分析法在更高阶段上的运用。它已经不仅是单个矿床类型的对比，不仅是两个地区成矿条件的对比，而是进行了更高级抽象后的综合对比。无疑，这对于

指导找矿具有重要的实际意义。

总之,《中国矿床模式》是对中国矿床最基础的总结研究,正如该书指出的,其他模式——成矿模式、找矿模式、数学模式等等,都必须以矿床模式研究为基础。很难设想,没有建立起较完善的矿床模式,其他模式如何能取得其应有的效果。因此,为了适应新一轮找矿评价工作的需要,希望广大矿产地质勘查工作者、有关科研和教学工作者进一步积累经验,不断地充实完善和发展中国矿床模式。希望该书的出版会对我国地矿事业起到促进与推动作用,并扩大对外学术交流,使我国地质科学水平更上一层楼。

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前 言

我国版图辽阔，地质构造复杂，产出矿种比较齐全。数十年来，随着地质勘查工作的深入发展和岩矿测试技术的进步，对于各种类型矿床的成矿地质环境、赋存产出特征、矿石物质组分和主要控矿条件等问题的研究都取得了新进展。70年代，地质矿产部地质矿产司组织专业人员，对研究程度较高的矿床开展“典型矿床总结”工作，并对矿床模式的建立进行了探讨。80年代后，在我国“六五”和“七五”期间，国家和地质矿产部组织有关科研单位、高等院校和生产部门的主要技术骨干，依据国民经济建设需要，对我国主要地质找矿问题开展了（国家或部级）科学技术攻关。其中在我国主要成矿区带深层次的研究中，通过矿床类型的划分、成矿机制的阐明、控矿条件的分析和成矿规律的总结，对不同矿种建立了不同的矿床模式。这项成果不但深化了对各个地区成矿条件与成矿作用的认识，把我国矿床地质研究提高到一个新水平，而且为今后的地质找矿工作提供了新思路与新途径。地质矿产部科学技术司对于这项科技研究成果极为重视，并依据朱训部长在“七五”期间科学技术成果交流会上，关于“做好科技成果转化工作”的讲话精神，决定将“五五”、“六五”、“七五”期间承担国家攻关项目、部科技攻关项目和重点科技项目中所取得的矿床模式研究成果进行汇总，并编著成《中国矿床模式》一书，以便及时地将研究成果应用到地质找矿实践中，使第一线工作的广大地质工作者从中能得到借鉴与参考，从而提高地质找矿的效果。据此，地质矿产部科学技术司1991年8月以地技字〔1991〕86号文件下达了任务，决定委托中国地质科学院矿床地质研究所具体承担《中国矿床模式》一书的资料收集、加工、整理及编撰等工作，并且对编写的目的、任务及指导思想进行了认真的研究和具体的部署，同时成立了以裴荣富研究员为首的编委会，负责具体编撰工作。

《中国矿床模式》一书的编写工作基本上可分四个阶段：第一阶段（1991年9月至1992年4月）为筹备与征集阶段，建立了组织，制定了矿床模式编写要求，同时向有关单位与个人发出了征集函。第二阶段（1992年4月至12月）为加工、编写阶段，对各单位和个人编写的矿床模式的文稿进行分选、修编，使其编写格式取得一致。第三阶段（1992年12月至1993年2月）为内部审核阶段，将所编写的各个矿床模式请有关专家初审，提出意见，进行修改。第四阶段（1994年2月至5月）为定稿阶段，进行文字录排、图件清绘和验收评审的准备工作。在此必须指出，本书所收入的每个矿床模式虽然是由不同作者编写的，并且每篇最后亦都保留有作者的署名，但是，编委曾据作者所提供的每个模式内容，结合公开发表的文献资料与最新研究成果进行了大量分析、研究工作，进行了补充、修改，并按统一格式作了修编、改编或重编，特别是对全部矿床模式进行了地质环境分类和在提高矿床模式普遍属性的思想指导下进行了统编。所以，本书不是各编者编写的矿床模式的合订本，而是在编委新思维指导下，集体的综合研究成果。

《中国矿床模式》一书在编写过程中共征集到244个矿床模式，经专家评定后选取了其

中 92 个模式编入本书。本书 92 个矿床模式是根据 425 个矿床的研究成果而建立的。它覆盖了我国除天津、上海之外的 28 个省、市、自治区。书中所涉及的矿种包括铁、铜、铅、锌、钴、镍、钨、钼、铋、锑、汞、锡、铬、钒、钛、锰、铀、金、银、铌、钽、铝、磷、稀土、铍、锂、钾、镁、硼、金刚石、石棉、滑石、沸石、明矾石、叶蜡石、萤石、橄榄石、天然碱、石膏、高岭土、芒硝、盐岩、菱镁矿、石墨、重晶石等 45 个矿种。参加矿床模式一书编写的有科研、教学与生产等 28 个单位。它们是地质矿产部的矿床地质研究所、地质研究所、天津地质矿产研究所、沈阳地质矿产研究所、西安地质矿产研究所、宜昌地质矿产研究所、成都地质矿产研究所、南京地质矿产研究所、中国地质大学、长春地质学院、冶金部鞍山钢铁公司、武警黄金指挥部第十一支队、地质矿产部的内蒙古 103 地质队、内蒙古地质研究队、山西省地质科学研究所、河北第三地质队、河北第十一地质队、黑龙江第一地质勘查所、黑龙江第二地质勘查所、浙江地质科学研究所、广东 719 地质队、陕西第六地质队、甘肃地质矿产局、甘肃酒泉地质队、四川地质矿产局、四川川东南地质队、云南地质矿产局和贵州地质矿产局。参加编写的人员共 105 人，其中有国内外享有声誉的矿床专家，也有长年工作在生产第一线的地质人员；有年逾古稀的老教授、老专家，也有年富力强的硕士生、博士生。他们在编写中引用了约 550 篇参考文献，提供了数百张图件，对其中某些部分经过几度修改，表现出了高度严谨的作风。

《中国矿床模式》的编纂工作是在裴荣富先生的直接指导下进行的。董建华、张洪涛负责组织协调。芮宗瑶、胡云中、刘群、宋学信、袁忠信、赵一鸣、叶庆同等参加了初审、筛选和修改工作。统编工作由主编和副主编负责。北京铀矿地质研究院、地质矿产部、中国地质大学（北京）有关专家审查、修改了部分模式。编纂过程中矿床地质研究所傅子洁、樊莉、熊群尧分别承担了绘图、打字、校对工作。

谨此，对上述单位和个人一并表示衷心感谢。

《中国矿床模式》编委会

PREFACE

China has a vast territory, where there occur complex geological structure and a relatively complex range of mineral commodities. For a few decades, with the development of geological exploration and progress in techniques of rock and mineral analysis, new advances have been made in studies of metallogenic environment, modes of occurrence, ore composition and major ore—controlling conditions of various types of mineral deposits. During the seventies the Department of Geology and Mineral Resources of the Ministry of Geology and Mineral Resources (MGMR) organized related professional persons to make a summary of typical deposits that had been studied intensively and to study the construction of mineral deposit models. In the Sixth and Seventh Five-Year Plan periods during the eighties, the State and the Ministry of Geology and Mineral Resources organized the key technical personnel of related scientific research organizations, institutions of higher learning and production sectors to carry out key (national or ministerial) scientific and technological projects concerning mineral prospecting according to the needs of the economic construction. In the intensive study of major metallogenic provinces and belts in China, different mineral deposit models were constructed for different mineral commodities by means of the classification of mineral deposit types, study of metallogenic mechanisms, analysis of ore-controlling conditions and summing-up of metallogenic regularities. This research achievement has not only deepened our understanding of ore-forming conditions and processes in various areas and raised China's research level on the geology of mineral deposits, but also provided new ideas and channels for mineral prospecting in the future. The Department of Science and Technology, MGMR, paid great attention to this research achievement, and in light of the spirit of Minister Zhu Xun's speech "Do a Good Job of Translating Research Achievements" at a meeting of exchanges of scientific and technological achievements scored during the Seventh Five-Year Plan period, the Department decided to gather all the research results of mineral deposit models obtained in undertaking national, ministerial and key scientific and technological projects during the periods of the Fifth, Sixth and Seventh Five-year Plans and to compile a book entitled "Mineral Deposit Models of China" in order to apply the research results to the practice of mineral prospecting in time and enable the broad masses of geological workers at the fronts to use these research results for reference so as to carry out mineral prospecting more effectively. Thus the Department of Science and Technology issued Di Ji Zi Document No. 86 (1991) in August 1991, which defined the purpose,

task and guiding principles of the compilation of the book "Mineral Deposit Models of China". According to the Document, the Institute of Mineral Deposits (IMD) of the Chinese Academy of Geological Sciences (CAGS) was entrusted to be in charge of the compilation of the book, including the collection and elaboration of data, and an editorial committee headed by Pei Rongfu, Senior Research Fellow of CAGS, was established to be in charge of concrete editorial work.

The editorial work of the book essentially involved four stages. The first stage (from September 1991 to April 1992) was a stage of preparation and solicitation of contributions, during which an editorial committee was established, requirements of compilation of mineral deposit models were laid down and letters for contribution were issued to relevant organizations and individuals. The second stage (from April to December 1992) was a stage of elaboration and compilation, during which manuscripts of mineral deposit models sent by various organizations and individuals were sorted and revised so that they had a unified format. The third stage (from December 1992 to February 1993) was a stage of internal examination, during which relevant experts were invited to examine all the mineral deposit models thus compiled and give their opinions and then the models were revised. The fourth stage (from February to May 1993) was a stage of finalization of the manuscripts, during which the manuscripts were entered and composed, maps were fair-drawn and preparatory work of evaluation and acceptance was done. Here it must be pointed out that although the mineral deposit models included in the book were contributed by different authors and the names of these authors are put at the end of each contribution, the Editorial Committee has done a lot of work in analyzing and studying, supplementing and revising the contents of these models in accordance with the published literature and the latest research results and revised or recompiled these models according to the unified format, and particularly classified all the mineral deposit models on the basis of the geological environment and made a unified compilation in line with the idea of making the mineral deposit models more applicable. So this book is not a file of mineral deposit models compiled by various geologists but a collective, integrated research result achieved under the guidance of the new thoughts of the Editorial Committee.

In the course of compilation of the book "Mineral Deposit Models of China", a total of 244 deposit models were collected, of which 92 were selected and incorporated in the book after assessment of experts. The 92 mineral deposit models in the book were constructed on the basis of research results of 425 mineral deposits. They cover 28 provinces, municipalities and autonomous regions except Tianjin and Shanghai. Forty-five mineral commodities are involved in the book, including iron, copper, lead, zinc, cobalt, nickel, tungsten, molybdenum, bismuth, antimony, mercury, tin, chromium, vanadium, titanium, manganese, uranium, gold, silver, niobium, tantalum, aluminum, phosphorus, rare earth metals, beryllium, lithium, potassium, magnesium, boron, diamond, asbestos, talc, zeolite, alunite, pyrophyllite, fluorite, olivine, trona, gypsum, kaolin, mirabilite, halite, magnesite, graphite and barite. Twenty-seven scientific research institutes and geological bureaus and field parties took part in

the compilation of the book; they were the Institute of Mineral Deposits, Institute of Geology, Tianjin Institute of Geology and Mineral Resources, Shenyang Institute of Geology and Mineral Resources, Xi'an Institute of Geology and Mineral Resources, Yichang Institute of Geology and Mineral Resources, Chengdu Institute of Geology and Mineral Resources and Nanjing Institute of Geology and Mineral Resources under the MGMR, China University of Geosciences, Changchun University of Geosciences, the Anshan Iron and Steel Company and the 11th Detachment of the Gold Headquarters of the Ministry of Metallurgical Industry, No. 103 Geological Party of Inner Mongolia, Institute of Geology of Inner Mongolia. Institute of Geological Sciences of Shanxi province, No. 3 Geological Party of Hebei Province, No. 11 Geological Party of Hebei Province, No. 1 Geological Survey of Heilongjiang Province, No. 2 Geological Survey of Heilongjiang Province. Zhejiang Institute of Geological Sciences, No. 719 Geological Party of Guangdong Province, No. 6 Geological Party of Shaanxi Province, Bureau of Geology and Mineral Resources of Gansu Province, Jiuquan Geological Party of Gansu Province, Bureau of Geology and Mineral Resources of Sichuan Province, Southeastern Sichuan Geological Party of Sichuan Province, Bureau of Geology and Mineral Resources of Yunnan Province and Bureau of Geology and Mineral Resources of Guizhou Province. A total of 105 persons participated in the compilation, including both experts in mineral deposits who are renowned both at home and abroad and geologists who have worked at the fronts for years, both aged professors and experts and young and vigorous masters and doctors of geology. In their compilation they cited about 550 references, provided a few hundred maps and revised some points in the maps several times, which reflects their rigorous scientific approach to the compilation.

The editorial work proceeded under the direction of Pei Rongfu, and Dong Jianhua and Zhang Hongtao were responsible for organization and coordination of the work. In the course of editing, Rui Zongyao, Hu Yunzhong, Liu Qun, Song Xuexin, Yuan Zhongxin, Zhao Yiming and Ye Qingtong examined, sifted out and revised each model seriously. After models were determined, the chief editor and deputy chief editor did a lot of work on the supplementation and elaboration of the selected manuscripts to standardize them according to the unified format. After finalization, the editorial committee classified the mineral deposit models on the basis of their features and geological environments combined with the geological-tectonic framework of China and wrote an introduction of the volume. Besides, 4 new deposit models were added, 11 deleted, 19 rewritten and 8 revised according to the opinion of the examination and assessment committee. Then part of the manuscripts of the volume were sent to the Academy of Uranium Geology, Ministry of Geology and Mineral Resources, China University of Geosciences (Beijing) and relevant experts for review, examination and revision.

The compilation of this volume would be impossible without the support and active contributions of the above-mentioned organizations and individuals. Fu Zijie of the Institute of Mineral Deposits drafted the figures, Xiong Qun Yao read the proofs and Fan Li typed and photostet the manuscripts. We would like to express our sincere thanks to them for their assistance.

The Editorial Board of MINERAL DEPOSIT MODELS OF CHINA