

中国
油藏
开发
模式
丛书

中国油藏开发模式 总论

GENERAL · RESERVOIR DE-
VELOPMENT MODELS IN CHINA

王乃举 等编著

石油工业出版社

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中国油藏开发模式丛书
Series on Reservoir Development Models in China

中国油藏开发模式 总 论

General Reservoir Development Models in China



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内 容 提 要

《中国油藏开发模式丛书》是一套系列性科技专著，是中国油田开发数十年经验的总结和概括，由全国 50 多名石油专家及数百名工程技术人员参与撰写。

《中国油藏开发模式·总论》综述了中国油田开发的现状及开发历程，论述了中国典型陆相油藏的地质特征和注水开发特点，详述了开发过程中针对油藏特点所采取的做法及其配套技术系列。不仅对中国油藏开发具有现实指导意义，而且也丰富和发展了世界油藏开发理论技术宝库。

本书可供从事油田开发、勘探及相关工作的各级领导干部、工程技术人员、研究人员及石油院校有关专业师生参考。

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序

早在1987年，王涛同志在大庆的一次会议上提出，我国的油田开发有着丰富的实践经验，需要总结一套油藏开发模式，以便对新油田开发和老油田提高水平做出指导。在此之后，中国石油天然气总公司开发生产局、科技发展局、北京石油勘探开发科学研究院组织了全国五十多名专家和数百名工程技术人员，历经八个年头，终于完成了这套《中国油藏开发模式丛书》的编写工作，现在就要出版同广大读者见面了。这是我国油田开发理论研究的系列成果，也是石油工业出版界的一件大事，值得庆贺！

《中国油藏开发模式丛书》包括总论、不同类型油藏开发模式专著和典型油藏开发实例三个部分。丛书共计40册，大约1500万字。它凝结着我国油田地质、油藏和采油工程科技人员的辛劳和智慧，是数十年油田开发实践中成功经验与失败教训的高度概括，从中可以窥见到中国式的油田开发工程的一些特色。

需要指出的是，在本书出版之前，石油科技信息研究所及有关油田曾经编纂出版了一套《国外不同类型油藏开发历程及工艺技术系列研究》成果，它是本丛书的姊妹篇，国外油田开发经验为《中国油藏开发模式丛书》的编著起到了借鉴作用。

前几年我曾经讲过一个认识，“抓产量不等于抓开发”。就是说油田开发有许多科学道理，有它自身的一些规律性，只有老老实实在地按照科学规律，不断提高新老油田的开发水平，才会有产量，也才会有更好的开发效益。我希望从事石油工作的同志，特别是油田开发工作者，能够抽时间读一读或者有选择地读读这套丛书，一定会得到不少的收益。成功和失败都是我们前进的基石，摆在我们石油工作者面前的路是宽广的，也是曲折的，让我们继续奋斗吧！

周永康
一九九〇年八月

Preface

In the early of 1987, at a Daqing meeting, Dr. Wang Tao stated that China has accumulated rich expertise on its oil and gas development. To guide its oil and gas development and improve the current technologies to the next level in both developed and un-developed reserves, it is worthwhile to establish and summarize its reservoir development models. Since then, the Development and Production Bureau, the Science and Technology Development Bureau and the Research Institute of Petroleum Exploration and Development of China National Petroleum Corporation (CNPC) have gathered more than fifty distinguished experts and hundreds engineers to achieve this objective. After eight years, The *Series on Reservoir Development Models in China* is ready to be published. This is a significant achievement in the theoretical studies on Chinese oilfield development. This is also an important event in Chinese petroleum publishing industry.

Series on Reservoir Development Models in China which consists of 40 volumes and approximately 15 million Chinese characters has three sections of *General, Reservoir Development Models Characterization* and *Typical Field Case Histories*. It is a result of hard works and distinguished intelligences of Chinese professionals in oilfield geology, reservoir engineering and production engineering. It is also a comprehensive summary of successful oilfield practice and lesson in China. In this series, reader will see some unique characteristics in Chinese oilfield development practice.

It should be point out that prior to the publication of this series, another series: *Development Histories and Production Technologies of Various Foreign Reservoirs* was compiled and published. It is a companion series to this domestic series. *Series on Reservoir Development Models in China* has referred the development experience from other countries.

Few years ago, I once said: “Increasing in production does not equal to the increasing in development technologies”. In other words, the oilfield developments are governed by physical laws. The development processes have many scientific principles that need to be followed faithfully. By improving our technologies, we will increase our production, and economic efficiency. I suggest that people in our industry, especially those who involve in oilfield development practice should read this series or at least read some volume of this series. I fully believe that readers would be benefited from their reading. Our successes and failures are the bases to advance further. The future of our industry is promising. However, we are going to face many difficulties and challenges. Let all of us do our best for future success!

Zhou Yongkang
August 1996

编 著 说 明

近五十年来,我国已开发了 10 多种类型的 892 个油藏,积累了丰富的实践经验。在这一历史发展进程中,石油工业部门的历届领导,对油田开发的科技发展给予了极大的关注和指导。作为石油部门的主要领导人余秋里、康世恩等亲自组织油田开发技术人员调查研究国外油田开发经验,研究油田的开发对策。尤其是康世恩同志,亲临科研和技术攻关第一线,与专家共同研究,集思广益,提出了许多宏观的技术思路。在他们的具体指导和推动下,油田开发科学技术有了重大的发展。但过去我们对油藏开发的研究和总结工作,尚未完全摆脱具体油藏和开发阶段的局限。为了增强油藏开发决策的科学预见性,提高经济效益,形成有针对性的油藏开发方式、程序和配套的工艺技术系列,原石油工业部决定,组织一批专家,总结研究不同类型油藏的开发模式。

建立不同类型油藏的开发模式,是在大量实践的基础上,深入剖析油藏地质和流体运动特点,揭示各种因素的内在联系,总结油藏在开采过程中的变化规律,从而提出不同类型油藏的开发对策,为今后高效开发新油藏,提供参考和借鉴。

把几十年的实践经验提高到理论规律的认识,是油田开发研究工作的一次飞跃。特别是中国油藏,大多属于陆相沉积储集层,相对于海相沉积储集层的油藏有着更多的复杂性。这样的理论概括不仅对中国油藏开发有现实指导意义,而且也丰富和发展了世界油藏开发理论技术宝库。

1987 年,由谭文彬同志负责,组成了《中国油藏开发模式丛书》工作指导小组,前后做了近三年的筹备工作,主要是研究工作思路,进行油藏分类和组织编写队伍;1990 年,《中国油藏开发模式丛书》的编写,正式列入原中国石油天然气总公司“八五”重点科研项目;1995 年,为了加快丛书的编写出版工作,在周永康总经理的关注下,组成了新的丛书编审委员会,周永康任编委会主任,谭文彬、王乃举任副主任,委员有:曾宪义、沈平平、金毓荪、张家茂、周成勋、万仁溥、刘万赋、冈秦麟。

编委会的具体组织领导工作由王乃举同志负责。为了加强经常的工作指导,还成立了编辑工作组,组长金毓荪,成员:李志勋、杨贤梅、李春如、张卫国、咸玥瑛。

在此期间,编委会先后组织多次研讨会,邀请各油田、院所的领导、专家、工程技术人员参加,确定了 28 个较为典型的开发区块,进而又综合成 8 种不同类型油藏开发模式。聘请了一大批著名专家撰稿,每一个项目都配备若干名工作人员,他们做了大量艰苦细致的专题研究、查阅文献及现场调研。原中国石油天然气总公司开发生产局、科技发展局在研究经费上给予大力支持,保证了丛书编写工作的正常运行。

1997 年 3 月,在《中国油藏开发模式丛书》典型实例已正式出版 10 多册之际,原中国石油天然气总公司在北京举行首发式,国家新闻出版署、中国海洋石油总公司、中国新星石油公司,以及各石油管理局和院校都派出代表参加了会议,与会同志对《中国油藏开发模式丛书》的出版,给予了高度评价。

随着丛书典型实例的陆续出版,编委会又及时组织了油藏分类模式的总结研究,遴选

了几位既有实践经验，又有理论水平的老专家负责，用三年左右的时间完成了8种类型油藏开发模式的专著，并相继出版。

在丛书分类模式的编写工作正常开展之后，编委会就把较多的精力放在丛书总论的研讨上。不言而喻，人们对中国油藏开发模式总论的要求更高。1997~1998年间，曾组织专家先后五次编写、讨论、修改“总论”的提纲，1999年上半年又对“总论”初稿做过两次较大规模的讨论评审，最后于1999年10月由丛书编委会审查定稿。

丛书总论的主要编著人有：

王乃举、金毓荪、裘恂楠、冈秦麟、曾宪义、万仁溥、李道品、贾文瑞。

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《中国油藏开发模式丛书》是一套系列性科技专著，是中国油田开发数十年经验的总结。全书分总论、不同类型油藏开发模式专著及油藏开发典型实例三部分，最后定稿为36册约1300万字。从1987年到今，历时十二载，先后有我国油田地质、油藏和采油工程系统五十余名专家和数百名工程技术人员参与全书的编写和研讨，这里凝结着他们的辛劳和智慧。需要指出的是，这套模式丛书不是作者个人专著的合成，而是我国油藏开发系统有代表性的专家和技术人员的集体创作，特别是分类模式和总论，都是由编委会组织相关专家多次讨论而成稿的，编委会对丛书的科学性和技术论点负责。丛书的参考文献仅列出了正式出版物的有关作者；引用的一些内部出版物作者的材料，本书没有列出，特予说明。在丛书的出版过程中石油工业出版社做了大量工作。编委会对所有参加本丛书编写、研讨、出版和曾经给予大力支持的各界人士谨致衷心地感谢。

Editor's Note

For the past half century, China has developed 892 reservoirs in more than ten different categories, and has accumulated a wealth of experiences. However, reservoir development studies were limited to particular reservoirs, and accumulated knowledge was contained in development phase. In order to enhance the scientific foresight in reservoir development strategies, increase economic efficiency, establish development strategies, procedures and related production facilities, China National Petroleum Corporation (former Ministry of Petroleum Industry) has gathered a group of industry experts to summarize and establish development models of various reservoir types.

The establishment of various reservoir models is based on enormous development practices through comprehensive reservoir geology characterization, fluid flow studies, exploration of the insight relationship of various factors, and summarization of the production process pattern. These models provide not only the development strategies for various reservoirs in production but also the guidance for the development strategies of new reservoirs.

Summarizing the field experiences accumulated in decades and establishing related development theories is a leap forward in Chinese oilfield development studies. Especially, most of Chinese domestic reserves are in continental deposits, which are much more complicated to develop than those in marine deposits. The theoretical summarization on the oilfield development has not only a significant impact on Chinese reservoir development studies but also a enrichment to the development theory studies internationally. It is our contributions to the petroleum industry worldwide.

In 1987, a group headed by Professor Tan Wenbin was formed in preparation of the *Series on Reservoir Development Models in China* publication. During a three-year period, the group focused on the publishing plans, organization setups as well as reservoir categorization. In 1990, the compilation of the *Series on Reservoir Development Models in China* formally started. It was listed by CNPC as one of the key scientific research projects of "Eighth Five Year Plan" of CNPC. In 1995, an editorial committee chaired by Professor Zhou Yongkang, the president of CNPC, was set up to speedup the series publication. In addition, Professors Tan Wenbin and Wang Naiju were appointed as vice chairmen of the committee. Professors Zeng Xianyi, Shen Pingping, Jin Yusun, Zhang Jiamao, Zhou Chengxun, Wan Renpu, Liu Wanfu and Gang Qinlin were appointed as committee members.

Professor Wang Naiju was responsible for the daily management of the editorial committee. A editorial working group, which was comprised of Professors Jin Yusun (lead), Li Zhixun, Yang Xianmei, Li Chunru, Zhang Weiguo and Xian Yueying, was set up to be in charge of editorial matters.

During the editing period, the committee organized series of symposiums involving field managers, experts, engineers and specialists all over Chinese oilfields, universities and research institutes. Twenty-eight reservoir blocks have been selected to establish eight different categories of reservoir development models by the participants. Many experts assisted by dozens of staffs were invited to draft the articles for each category. They performed large amount of detailed studies, literature searches and field investigations. The Development & Production Bureau and Science & Technology Development Bureau of CNPC provided sufficient funding for this publication.

The first publication ceremony of the Series was held by CNPC in Beijing in March 1997 when the first volumes of over ten *Typical Field Case Histories* was published. The participants from News and Publications Administration of China, China National Offshore Oil Corporation (CNOOC), China National Star Petroleum Corporation (CNSPC), Oilfields, Universities and Research institutes highly praised the publication.

In succession to the publications of the *Typical Field Case Histories*, the editing works on the categorization of various reservoir development models were timely organized. During three years, several distinguished senior experts with recognized achievements took the responsibilities for the compilation of eight types of reservoir development models. Eight monographic volumes were published successively.

In the beginning of compilation on reservoir development models categorization, the editorial committee mainly concentrated on the publication of the *General* of the series. Without question, The *General* on Chinese reservoir development models are of highly expected significance. During 1997 to 1998 period, the committee and a collective experts group have discussed and revised the outlines on *General* for five times. In the first half year of 1999, the draft of *General Statements* has gone through two major revisions. The editorial committee passed the final version in October 1999.

The editors and authors of *General* include: Wang Naiju, Jin Yusun, Qiu Yinan, Gang Qinlin, Zeng Xianyi, Wan Renpu, Li Daopin, and Jia Wenrui.

Other participants include:

Tan Wenbin, Shen Pingping, Zhang Jiamao, Pan Xingguo, Liu Wanfu, Liu Wenzhang, Chen Xiakan, Yuan Qingfeng, Chen Yongshen, Fan Naifu (deceased), Huang Xinsheng, Han Yongguang, Liu Yufen, Yue Dengtai, Jiang Wenda, Xiao Jinxiou, Zhao Shiyuan, Chen Shiming, Gong Lin and Jiang Tian.

The *Series on Reservoir Development Models in China* is a set of scientific and technological monographs which summaries decades long experiences in Chinese oilfield developments. This series consists of three sections including *General*, *Reservoir Development Models Characterization*, and *Typical Field Case Histories*. The final version has thirty-six volumes with approximately thirteen million Chinese characters. From 1987 to its publication, for a decade, more than fifty experts in geology, reservoir and production engineering, as well as hundreds field

engineers, involved in its compilation. These achievements are the representation of their hard works and distinguished intelligences.

It should be noted that the successes of publication of this series are attributed to chinese experts and engineers in reservoir development area. It is not an individual literature collection. Specially, the *General and Reservoir Development Models Characterization* have been went through many revisions of the experts organized by the editorial committee. The editorial committee is responsible for its scientific and technological contents. Also, it should be noted that the references listed in the series are only from the publications not from the internal documentation

The Petroleum Industry Press is responsible for the publication of the series. The editorial committee would like to take this opportunity to sincerely thank them and all of those involved in its compilation, discussion and publication. The committee also would like to thank all the people who have given us their support.

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