

中国油田开发丛书

李道品 等著

低渗透砂岩油田开发

THE DEVELOPMENT OF THE LOW PERMEABILITY SANDSTONE OIL FIELD

THE SERIES
OF OIL FIELD
DEVELOPMENT IN

CHINA



石油工业出版社

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内 容 提 要

本书采取油藏地质与工艺技术、理论与生产实践相结合的方式,对低渗透油藏的沉积、储层、裂缝、流体、渗流和开采特征进行了深入的论述,对油田开发中的经验教训进行了全面的总结和分析,在此基础上提出了低渗透油藏科学、合理及经济有效开发的基本原则、政策界线、方案部署和工艺技术措施。另外介绍了六个有代表性的不同类型低渗透油藏开发的实例和六个油区低渗透油田的发展前景。

本书可供从事油田开发的领导干部、科研人员和生产管理人员,以及有关院校师生参考。

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序

新中国成立以来，我国石油工业在党中央、国务院领导下，艰苦创业，取得了迅猛发展。特别是实行改革开放以来，我国石油、天然气产量持续稳定增长，科技水平和经营实力明显提高，发展进入到了一个新的阶段。

我国石油工业的发展历程，是一个艰苦的科学技术攻关的历程。这是由中国石油地质的特点决定的。我国现已开发的油气田，多为陆相沉积，地质构造复杂，断块发育，含油层系多，非均质性强，渗透性差别很大，原油性质多种多样。这些特征，都给我国油气田开发带来了许多特殊性和复杂性。40多年来，我国广大石油科技工作者和石油职工，在生产实践中不断探索，刻苦攻关，逐步发展创造了一套具有中国地质特点的陆相非均质油气田开发理论，以及相应的一整套陆相油气藏开发工艺技术和方法，推动我国油田开发不断发展达到了新的水平。

我国陆相油田开发是一场伟大的科学实践。《中国油田开发丛书》正是这一实践的总结。这套丛书，共分《复杂断块油田详探与开发》、《碳酸盐岩潜山油田开发》、《大庆多层砂岩油田开发》、《低渗透砂岩油田开发》、《砾岩油田开发》五册，比较系统地著述了我国陆相油田开发的实践与理论，展示了我国油田开发科学技术的成果和进步。相信它的编辑出版，必将给人以启迪，对指导今后油田开发起到积极的作用。同时也会有助于广大石油科技工作者和石油职工更好地了解我国石油工业的科技发展史，有助于世界更好地了解和认识中国的油气田开发工作和石油工业的发展，加强与同行之间的交流。这是一件很有意义和值得祝贺的事情。

石油工业在发展，科学技术在进步。我相信，经过我国广大科技工作者和石油职工坚持不懈的努力，中国陆相油田开发的理论和实践会不断有所创新，日臻充实和完善，推动我国油气田开发水平的不断提高和石油工业的发展。

王德林
1992.4.

前 言

90年代以来,在我国每年探明的石油地质储量中,低渗透油层储量所占的比例愈来愈大。

根据有渗透率资料的陆上探明石油地质储量统计,1989年探明低渗透油层(空气渗透率小于 $50 \times 10^{-3} \mu\text{m}^2$)地质储量为 $9989 \times 10^4 \text{t}$,占当年总探明储量的27.1%,以后比例逐年增加。1990年探明低渗透储量为 $21214 \times 10^4 \text{t}$,占当年总探明储量的45.9%;1995年探明的低渗透储量增加到 $30796 \times 10^4 \text{t}$,占当年总探明储量的比例高达72.7%,即每年探明的石油地质储量中,大约有三分之二为低渗透油层储量。

面对这种形势,不言而喻,低渗透油田的开发对石油工业的作用愈来愈大。因此,需要总结开发低渗透油田的成功经验,分析目前存在的矛盾,进一步改善开发效果,提高经济效益,争取有更多的低渗透油田投入开发,以保证石油工业的持续发展。

作者自1990年以来曾多次到全国各油田对低渗透油田开发状况进行调查研究,深刻体会到,我国广大油田开发工作者在低渗透油田的地质特征、渗流规律和开发动态、调整治理以及工艺技术等方面进行了大量、深入细致地研究和生产试验工作,并取得了显著成效。

由于低渗透砂岩油田储层的孔隙结构和表面物理性质极为复杂,其渗流机理、油水运动规律、开发模式以及开采工艺技术等方面都与一般中高渗透油田有很大的不同,涉及专业学科和工作范围很广,因而本书由相关专业的同志共同进行撰写。

本书各章执笔人:前言和绪论 李道品,第一章 李道品、罗迪强,第二章 刘雨芬,第三章 严衡文,第四章 穆龙新,第五章 皮广农,第六章 黄延章,第七章 罗迪强,第八章 李道品,第九章 胡博仲、徐志良和程兆惠,第十章由各油田有关同志执笔,刘秉璋做了部分整理,第十一章 李道品。全书由李道品统一修改、定稿。部分计算机制图由李家庆完成。成书过程中的初步编排工作由皮晓林完成。提要和目录由万玉金和单秀琴翻译成英文。

各典型低渗透油田开发实例主要执笔人:朝阳沟油田 潘锡阁等,新民油田 张宝忠等,马西深层 何鲜等,渤南油田 向桂嘉等,安塞油田 朱义吾,鄯善油田 张桂林等。

全书正式初稿完成于1995年12月。《中国油田开发丛书》编委会于1996年2月在北京召开了审稿会,会议由周成勋总工程师主持,参加人员有冈秦麟、蒋阆、葛家理、张朝琛、王鸿勋、吴湘、陈钦雷、孔秀兰、薄启亮、潘国潮、于庄敬、马世煜、武若霞、黄绍和、吕德本、张卫国、贾迎等。根据专家评审意见,进行了补充和修改。

本书在酝酿和拟定提纲过程中,得到王乃举、裘亦楠、周成勋、潘兴国、崔耀南、叶敬东等的支持和指导。在本书写作过程中,得到了咨询中心开发部唐曾熊、万仁溥、王平、吴湘等的热情支持和帮助,还得到大庆油田周望、张广成、岳广胜、杨嘉春、冯志昆,胜利油田王秉海、范乃福,吉林油田周受超,大港油田李学琦、朱光、倪方天,吐哈油田崔辉等的大力支持和帮助。作者曾多次向董宪章、秦同洛、朱兆明等老专家请教,他们都给予了热情的指导和帮助。本书在写作和修改过程中,李天相、谭文彬、李虞庚、金毓荪等同志给予了关心和支持,闫庆来、王治同、金静芷、陈元千、李淑贞、方宏长、刘兴汉、贾文瑞、桓

冠仁、王荷美、武若霞、谢兴礼、谢绪权、邢瑞林等给予了作者热情的帮助。对以上所有给予帮助的同志在此一并表示衷心的感谢。

本书所应用的资料和数据，都来自各个油田和有关科研院校，所以本书实际上是广大油田开发工作者共同辛勤劳动的成果。在文中对资料出处都尽可能地做了注明。

对低渗透油田的研究认识和开发治理技术，目前正在进一步发展和完善，涉及面很广。由于作者水平有限，书中难免有不当之处，敬请读者批评和指正。

李道品

一九九六年七月一日

The series of oil field development in China

The Development of The Low Permeability Sandstone Oil Field

ABSTRACT

In this book, the authors deeply expound characteristics of sedimentation, reservoir, fracture, fluid, porous flow and development; wholly sum up and analyze the experiences and lessons about reservoir development by means of combining reservoir geology with engineering, theory research with practice. On this basis, the authors have pointed out the principle of reasonable and economic efficient development for low permeability field. In addition, the authors have introduced six different kinds of typical examples about low permeability reservoir development and developing prospects of low permeability reservoirs in six oil fields. It is a good reference book to managers, engineers who work in the field of reservoir development and to teachers and students in universities and institutes.

The series of oil field development in China

The Development of The Low Permeability Sandstone Oil Field

CONTENT

INTRODUCTION

References

CHAPTER 1. THE CONCEPT OF LOW PERMEABILITY OIL FIELD AND ITS RESERVE DISTRIBUTION SITUATION IN CHINA

1. The concept and limits of low permeability oil field
 - (1) Upper limits of low permeability oil-bearing reservoirs
 - (2) Lower limits of low permeability oil-bearing reservoirs
 - (3) Classification of low permeability oil field
2. Reserve distribution situation of low permeability oil field
 - (1) Low permeability oil fields extensively distribute in oil provinces
 - (2) Low permeability reservoir can be formed in strata of different geological period, in the same oil province, low permeability reservoirs has a higher proportion in old strata than in younger strata
 - (3) The majority of discovered low permeability reservoirs are in mid-deep burial depth
 - (4) The majority of low permeability reservoirs are in mid-large scale
 - (5) The low permeability reservoirs can be distributed in all kinds of lithological strata
 - (6) Structural-lithological reservoir is the major type of low permeability reservoirs
 - (7) Extra-low permeability reservoir account for a very high proportion in low permeability reservoir
 - (8) The properties of oil in low permeability reservoir are better

References

CHAPTER 2. RESERVOIR SEDIMENTATION AND DISTRIBUTION FEATURES OF LOW PERMEABILITY OIL FIELD

1. Outline of reservoir sedimentation features of continental oil-bearing basin and genetic classi-

fications of low permeability reservoir

- (1) Outline of deposit features of continental oil-bearing basin
- (2) Genetic classification of low permeability reservoirs
2. Features of low permeability reservoir of proximal deposit
 - (1) Piedmont—alluvial fan reservoir
 - (2) Alluvial fan—braided stream deposit—rudaceous sandstone reservoir
 - (3) Underwater fan deposit—glutenite deposit
 - (4) Sublacustrine fan gravity current deposit
3. Features of low permeability reservoir of distal deposit
 - (1) Fluvial deposit
 - (2) Deltaic deposit
4. Low permeability reservoir features forming by diagenesis
 - (1) Low permeability reservoir formed by compaction and cementation
 - (2) Low permeability reservoir formed by compaction-cementation and denudation
5. Reservoir heterogeneous features of low permeability oil field

References

CHAPTER 3. PHYSICAL PROPERTIES AND PORE STRUCTURE FEATURES OF LOW PERMEABILITY RESERVOIR

1. Lithology features of low permeability reservoir
 - (1) Grain size parameters of low permeability reservoir
 - (2) Mineral compositions of low permeability reservoir
 - (3) Status and contact relations of detrital particles in low permeability reservoir
 - (4) Cements and cementation types
2. Physical properties of low permeability reservoir
 - (1) Porosity of low permeability reservoir
 - (2) Permeability of low permeability reservoir
 - (3) Oil-water saturation of low permeability reservoir
 - (4) Major factors controlling physical property of low permeability reservoir
 - (5) Relation between porosity and permeability
 - (6) Correction of porosity and permeability
3. Pore structure features of low permeability reservoir
 - (1) Morphological structure feature of reservoir porous space
 - (2) Pore microstructure feature
 - (3) Pore structure heterogeneity (i. e. micro-heterogeneity) of low permeability reservoir
 - (4) Major factors affecting pore structure
4. Surface physical property features and water driving oil efficiency of low permeability reservoir
 - (1) Wettability of low permeability oil-bearing formation
 - (2) Influence of wettability to water driving oil efficiency
 - (3) Specific surface

5. Sensitivity of low permeability reservoir

- (1) General causes and types of oil – bearing formation damage
- (2) Microparticle clay mineral types and its sensible features of low permeability reservoir
- (3) Sensible type evaluation and mechanism test analysis of clay minerals in low permeability oil-bearing formation
- (4) Forming, preventing and treatment of the filth—a new mineral separated from oil field water injection development

6. Comprehensive classification evaluation of low permeability reservoir

- (1) The basic principles and parameters of classification and evaluation
- (2) Comprehensive classification and evaluation of the low permeability reservoir

References

CHAPTER 4. FRACTURE FEATURES AND ITS RESEARCH METHODS OF LOW PERMEABILITY RESERVOIR

1. Outline

2. Geological features of nature fracture

- (1) Genesis feature
- (2) Occurrence feature
- (3) Development feature
- (4) Scale feature
- (5) Starting feature
- (6) Porosity and permeability features
- (7) Dynamic feature

3. Identification of natural fracture system

- (1) Observation and description of fractures in core
- (2) Observation and description of fractures in outcrop
- (3) Identification methods of fractures by logging
- (4) Dynamic identification mark of fractures
- (5) Measurement and analysis of ground stress

4. Characteristics of natural fractures

- (1) Determining main characteristic parameters of fractures
- (2) Establishing comprehensive profile of fractures
- (3) Dividing development belts of fractures
- (4) Carrying out numerical modeling of fracture
- (5) Predicting development regularity of fracture
- (6) Evaluating the possible influence of fracture system to development

5. Reservoir comprehensive classification and its main features of sandstone oil field with fractures

- (1) The classification of fractured reservoirs by predecessors
- (2) The classification and its main features in this book

References

CHAPTER 5. CRUDE OIL PROPERTIES, FORMATION PRESSURE AND DRIVE ENERGY FEATURES OF LOW PERMEABILITY OIL FIELD

1. Crude oil properties features of low permeability oil field
2. Formation pressure features of low permeability oil field
 - (1) Abnormal high pressure related with formation sedimentation and undercompaction
 - (2) Abnormal high pressure related with structural effect
3. Energy driving features of low permeability oil field

References

CHAPTER 6. OIL-WATER POROUS FLOW MECHANISM OF LOW PERMEABILITY OIL – BEARING FORMATION

1. Porous flow environment and physicochemical function
 - (1) Porous medium
 - (2) Surface molecule stress and capillary pressure action
 - (3) Crude oil boundary layer
2. Oil-water monophasic porous flow
 - (1) Porous flow complex nature of low permeability formation
 - (2) Experimental results of porous flow process in low permeability formation
 - (3) Mathematics equation of monophasic porous flow in low permeability oil-bearing formation
 - (4) Relations between starting pressure gradient and permeability
 - (5) Pressure distribution features at radial porous flow
 - (6) Influence of starting pressure to production of oil well
3. Two-phase porous flow in low permeability oil-bearing formation
 - (1) Continuous equation
 - (2) Oil-water motion equation
 - (3) Influence of starting pressure to variation of water cut
 - (4) Features of oil-water relative permeability in low permeability formation
 - (5) Recovery efficiency problem of low permeability formation

References

CHAPTER 7. DEVELOPMENT FEATURES OF LOW PERMEABILITY RESERVOIR

1. Low natural productivity, large production pressure head, but getting a big increase after fracturing
2. Taking depletion method to develop, production declining fast, pressure decreasing quickly, primary recovery being low
3. Low water receptivity of injection well, high starting pressure and injection pressure
4. Low injection efficiency, pressure and production less sensible than high permeability layer in oil well
5. High productivity in injection well, serious water breakthrough in oil well, in fractured sandstone oil field
 - (1) Injection well feature
 - (2) Oil well feature

- (3)Strictly controlling injection pressure and injection – production ratio
 - 6. Productivity index declining, high difficulty to stable production after water breakthrough in low permeability oil field
 - (1)Productivity index declining, high difficulty to stable production after water breakthrough in oil well
 - (2)In low water-cut stage, water-cut rising slowly, being important production period
- References

CHAPTER 8. BASIC PRINCIPLES AND DEPLOYMENT TO REASONABLE DEVELOPMENT OF LOW PERMEABILITY OIL FIELD

1. Development procedure of low permeability oil field
 - (1)Development involving precedingly, carrying out production capacity, optimum seeking enrichment blocks
 - (2)Going on early reservoir evaluation, working out development concept design
 - (3)Enhancing reservoir research experiment, working out and optimum seeking former general development plan
 - (4)Entirety arranging, implementing in turns, following the tracks of research adjusting in time
 - (5)Enhancing and perfecting injection and production system step by step
2. Development methods of low permeability oil field
 - (1)The analysis of the effect of different types of drive in low permeability oil field
 - (2)Water should be injected more early in order to keep up the reservoir pressure for the low natural drive energy oil field
 - (3)Water injection could be delayed in order to increase the water – free oil production for the oil field with strong elastic energy and abnormal high pressure
 - (4)Gas injection——another type of keeping up the reservoir pressure in development of low permeability oil field
3. Compartment and combination of layers of development on low permeability oil field
 - (1)The ordinary principles of compartment and combination of layers
 - (2)The specific cases of development on layer series low permeability oil field
4. Well density of low permeability oil field
 - (1)The significance of well density on the development of low permeability oil field
 - (2)The analysis of technical factors affecting reasonable well density of low permeability oil field
 - (3)The economical limit of well density
 - (4)Determination of reasonable and feasible well density
5. The layout of injection-production well pattern on the development of low permeability oil field
 - (1)The method and foundation of determination reasonable layout of spot flooding well pattern
 - (2)Determination of water injectivity of water injector

- (3)The practical uses of spot flooding well pattern
- 6. The arrangement of well pattern in fractured sand oil field
 - (1)The practical cases of water flooding well pattern of fractured sand oil field in our country
 - (2)The simple cases of water flooding well pattern layout of fractured sand oil field abroad
 - (3)The basic principles and steps of reasonable layout of water flooding well pattern in fractured sand oil field
- 7. The discussion about the problems of using horizontal well integrated water flooding to develop the fractured reservoirs and low permeability reservoirs
 - (1)The development of horizontal well technology
 - (2)The case of using horizontal well to develop fractured reservoirs and low permeability reservoirs
 - (3)The present situations and discussions of the problems of using horizontal well integrated water flooding to develop reservoirs
- 8. The establishment and evaluation of injection-production pressure system of low permeability oil field
 - (1)Production system
 - (2)Injection system
 - (3)The evaluation of injection-production pressure system
 - (4)Another evaluation method to injection-production system—the method of analyzing pressure balance map of injection-production system
 - (5)Determination of reasonable injection-production ratio
- 9. The method of enhancing oil recovery and improving water drive effect in low permeability oil field
 - (1)EOR technique
 - (2)The method to improve water drive effect
 - (3)Microorganism production

References

CHAPTER 9. THE MAIN PERFORMANCE TECHNOLOGY IN DEVELOPMENT OF LOW – PERMEABILITY OIL FIELD

- 1. Reservoir protection technology
 - (1)Oil formation protective technology in the process of drilling
 - (2)Oil formation protective technology in the process of well completion and cementing
 - (3)Oil formation protective technology in the process of perforation
 - (4)Oil formation protective technology in the process of fracturing
 - (5)Oil formation protective technology in the process of acidizing
 - (6)Oil formation protective technology in the process of water injection
 - (7)Oil formation protective technology in the process of production and down-hole servicing
- 2. High effective perforation technology
 - (1)High effective perforator
 - (2)Perforation technology

3. The technology of stimulation by hydraulic fracturing
 - (1) The technology of “overall hydraulic fracture” optimization design
 - (2) Hydraulic fracture technology
 - (3) repeated hydraulic fracture technology
 - (4) Fracturing fluids and proppant agents
4. High effective water injection technology
 - (1) The treatment technology of water quality
 - (2) The technology of pilot water flooding
 - (3) The technology of multi-zone injection regulating
 - (4) The technology of stimulation of injection well
 - (5) The reasonable pressure limit in water injection
5. The technology of mechanical producing, wax control and viscosity reduction
 - (1) The technology of pumping by sucker rod pump
 - (2) The lift process of screw pump with hollow rod and the necessary technology
 - (3) The technology of pumping by hydraulic piston pump
 - (4) The technology of pumping by submersed electric pump
 - (5) Air lift technology
6. The technology of performance monitoring
 - (1) The technology of pressure measurement
 - (2) The modern interpretation method of well test
 - (3) The technology of zonal testing in producing well
 - (4) The technology of water injection profile measurement in injection well
 - (5) The technology of meter using software
 - (6) Logging technique
7. The technology of surface flow sheet
 - (1) A complete set of techniques of brief single-tubing gathering facility in Ansai oilfield
 - (2) Gathering facility process of single tube mini-circulation with adding water
8. The producing technology of cluster directional well, horizontal well and slim – hole well
 - (1) The development technology of cluster directional well
 - (2) The development technology of horizontal well
 - (3) The producing technology of slim-hole well

References

CHAPTER 10. THE TYPICAL EXAMPLES OF THE DEVELOPMENT OF LOW PERMEABILITY OIL FIELD

1. Chaoyangguo oil field
 - (1) Geological characteristics of reservoir
 - (2) Development history and development level
 - (3) The major methods in oil field development
 - (4) The knowledge and conclusion
2. Xinmin oil field

- (1) Geological characteristic of reservoir
- (2) Development history and development level
- (3) The major methods in oil field development
- (4) The knowledge and conclusion
- 3. Maxi deep reservoir on north of DaGang oil field
 - (1) Geological characteristic of reservoir
 - (2) Development history and development level
 - (3) The major methods in oil field development
 - (4) The knowledge and conclusion
- 4. Bonan oil field
 - (1) Geological characteristics of reservoir
 - (2) Development history and development level
 - (3) The major methods in oil field development
 - (4) The knowledge and conclusion
- 5. Ansai oil field
 - (1) Geological characteristic of reservoir
 - (2) Development history and development level
 - (3) The major methods in oil field development
 - (4) The knowledge and conclusion
- 6. Shanshan oil field
 - (1) Geological characteristic of reservoir
 - (2) Development history and development level
 - (3) The major methods in oil field development
 - (4) The knowledge and conclusion

CHAPTER 11. SUMMARY AND PROSPECT

- 1. The brief summary on the development problems of low permeability oil field
 - (1) The major factors affecting the development effect in low permeability oil field
 - (2) The methods of increasing the oil well production and improving development effect
 - (3) The major ways of cutting down invests, reducing costs and increasing economic benefits
- 2. The future of low permeability oil field development in China
 - (1) The east of outlay regions in Daqing oil field
 - (2) Jilin oil field (The south of the Songliao Basin)
 - (3) Dagang oil field
 - (4) Shan-Gan-Ning Basin
 - (5) Xinjiang (The north of Xinjiang)
 - (6) The central region of Sichuan

References

目 录

绪论	(1)
参考文献	(3)
第一章 低渗透油田的概念及我国储量分布状况	(4)
第一节 低渗透油田的概念和界限	(4)
一、低渗透油层上限	(4)
二、低渗透油层下限	(5)
三、低渗透油田分类	(8)
第二节 低渗透油田储量分布状况	(9)
一、低渗透油田广泛分布于各个油区	(10)
二、不同地质年代的地层都可形成低渗透储层，在同一个油区相比较老地层 低渗透储层所占比例较高	(10)
三、目前发现的低渗透储层以中深埋藏深度为主	(11)
四、低渗透储层油藏以大中型油藏为主	(12)
五、低渗透储层分布于各种岩性中	(12)
六、低渗透油藏类型以构造岩性油藏为主	(12)
七、低渗透储层中特低渗透层占有相当高的比例	(13)
八、低渗透储层采油性质比较好	(13)
参考文献	(13)
第二章 低渗透油田储层沉积和分布特征	(14)
第一节 陆相含油气盆地储层沉积特征概述及低渗透储层成因分类	(14)
一、陆相含油气盆地储层沉积特征概述	(14)
二、低渗透储层成因分类	(20)
第二节 近源沉积低渗透储层特征	(22)
一、山麓洪积扇沉积——砾岩储层	(22)
二、冲积扇—辫状河沉积——砾状砂岩储层	(23)
三、水下扇沉积——砂砾岩储层	(23)
四、湖底扇重力流沉积	(24)
第三节 远源沉积低渗透储层特征	(25)
一、河流相沉积	(25)
二、三角洲相沉积	(26)
第四节 成岩作用形成的低渗透储层特征	(28)
一、压实胶结作用形成的低渗透储层	(28)
二、压实胶结及溶蚀作用形成的低渗透储层	(29)
第五节 低渗透油田储层非均质特征	(30)
参考文献	(32)