

贾承造 主编：塔里木盆地石油地质与勘探丛书 (卷十二)

TARIM BASIN

塔里木盆地

波动过程及其控油规律

金之钧 吕修祥 王毅 刘国臣 鲍志东 著

石油工业出版社
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内 容 提 要

本书从波动地质学研究出发, 落实盆地沉降及隆升剥蚀的形成过程, 分析地质历史时期中盆地波动演化对油气生成、运移、聚集和成藏的控制作用, 建立起定时和定量的概念。

本书可作为油气地质、构造地质学研究方面的中高级科技人员参考, 也可作为相关专业的硕士、博士生参考用书。

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序

以“九五”期间勘探与研究成果为内容的《塔里木盆地石油地质与勘探丛书》一套十二卷即将面世，这是“九五”期间奋战在塔里木盆地这块热土上的全体石油地质工作者集体劳动的结晶，也是石油工业出版社同志们辛勤劳动的产物。它是塔里木盆地油气勘探史上重要的一环。丛书的出版，必将引起国内外石油界的广泛瞩目和浓厚的兴趣，我对丛书的出版表示热烈祝贺。

塔里木盆地的油气勘探从20世纪50年代算起已经有50多年了，其间因为种种原因，经历了“几上几下”的曲折历程，也积累了丰富的资料和经验教训。1989年4月经国务院批准由中国石油天然气总公司组织了塔里木盆地石油会战，从而为在塔里木盆地大规模全面展开油气勘探迈出了扎实的历史性的步伐。与此同时国家也组织了相应的以塔里木盆地油气勘探为内容的“八五”和“九五”的重点攻关项目。

《塔里木盆地石油地质与勘探丛书》的内容，正是在广大石油工作者近40年野外和盆地周边地质调查和钻探、石油地球物理勘探局挺进大漠后连续苦干近20年所取得的丰硕资料，在“七五”和“八五”国家重点攻关研究工作的基础上，通过5年或更长时间的实践和研究所取得的成果，在此期间，对重点地区和重点层系进行了艰苦有效的研究和实践，应该说取得了令人满意的勘探成果，开创和深化了新的理论和认识，特别在复杂断裂构造带和碳酸盐岩中进行油气勘探，积累和丰富了大量储层描述和评价、地震采集和处理、测井、完井、试油等一系列理论、技术和工作方法。

“九五”期间，共发现或探明了13个大、中型油气田，27个工业性含油气构造。发现和探明了大型整装的克拉2大气田，探明天然气地质储量 $2840 \times 10^8 \text{m}^3$ ，发现了库车坳陷的富天然气聚集带，为“西气东输”奠定了资源基础；继续探明了塔河—轮南大油田。近5年来新增油气地质储量 $5.905 \times 10^8 \text{t}$ （当量），其中石油地质储量 $1.908 \times 10^8 \text{t}$ ，天然气地质储量为 $3997 \times 10^8 \text{m}^3$ ，2000年生产原油 $440 \times 10^4 \text{t}$ 。

通过“九五”期间勘探和研究，对库车前陆盆地石油地质的认识取得了重大进展，初步形成了库车大气区的石油地质理论基础；在古生代海相碳酸盐岩油气成藏规律研究、克拉通主力烃源岩评价、海相碳酸盐岩和碎屑岩储层发育机制及成藏期与成藏模式研究等方面，取得了新进展，丰富了海相石油地质理论，深化了对古老克拉通盆地海相油气分布规律的认识；对塔里木盆地石油地质的深入研究，明确了塔里木中、新生代盆地大地构造背景及包括塔里木盆地在内的特提斯北缘盆地群的油气地质特征；进一步总结和改善了塔里木盆地油气的富集成藏规律，评价优选出了一大批有利勘探区带和目标，明确了塔里木盆地油气勘探的战略发展方向，并形成了一系列油气勘探的技术和方法。

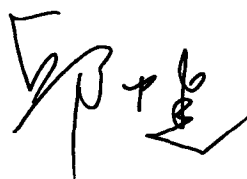
特别是库车前陆盆地创造性地运用断层相关褶皱理论，在库车前陆盆地褶皱—逆冲构造带建立了10种构造模型，并用于地震剖面精细构造解释和制图；应用煤成烃理论，深入分析和系统评价了库车前陆盆地三叠—侏罗系煤系地层烃源岩。提出库车前陆盆地发育分布广、厚度大、有机质丰度高、有机质类型以腐殖型为主、成熟度高的煤系地层烃源岩等，初步认识了库车大气区的石油地质特征。

针对山地地震勘探、高陡构造钻井、超高压气藏测试和评价、碳酸盐岩孔、洞、缝型储层的识别和预测及超深、低幅度薄层砂岩油藏勘探等一系列难题，加大了勘探技术攻关的力度，初步形成了五套油气勘探评价技术系列，基本满足了当前塔里木盆地油气勘探的需要。

这套丛书系统总结了“九五”及前人对塔里木盆地的勘探和研究工作，特点是总结了5年的勘探实践和认识。其中既有勘探的认识和基础研究成果，也有油气富集规律的总结和新技术、新方法的应用，内容十分丰富，对今后塔里木盆地乃至其它相似盆地的油气勘探有一定的借鉴意义。但我们认为，这些成果并不都是十分成熟、十全十美的，正相反，毕竟塔里木盆地情况十分复杂，勘探程度还比较低，许多难题还尚未解决，勘探的道路还很漫长，我们的认识虽有大的进步，但还有很多不清楚和不明白的环节和规律。可贵的是，塔里木盆地的石油地质工作者勇于实践，勇于探索，锲而不舍，不断进取，及时总结经验教训，敢于把这些成果亮出来，接受实践的检验，在实践中深化认识。我相信，这套丛书的出版，定会丰富中国石油地质学的理论与实践，并对今后的勘探工作起到重要的指导作用。

随着塔里木盆地油气勘探不断深入并取得更大进展，人们的认识将会更加接近客观实际和事物的本来面目，通过继续不断地努力和探索，定会实现油气勘探的飞跃。到那时，中国石油工业的希望——塔里木盆地，将出现更多的克拉2和塔河一轮南型的大型油气田，进入新的油气储量增长的高峰期，塔里木盆地真正成为中国石油工业战略接替基地，我对此充满信心。

最后，我衷心希望丛书的出版能够起到“抛砖引玉”的作用，能够在一定程度上满足全国石油地质界关心和支持塔里木盆地找油事业的专家同仁的需要，并引起更多人的兴趣，从而参加到塔里木盆地油气勘探的接力赛的行列中来，共同投身到富有诱惑、充满挑战而又奥秘神奇的塔里木盆地这块热土中来。

A handwritten signature in black ink, consisting of stylized Chinese characters that appear to read '尹建'.

2003年6月

Preface

The 12-volume collection of *Petroleum Geology and Exploration of Tarim Basin*, the content of which is the exploration and research achievements during the "Ninth Five-Year Plan" period, will be published. This collection is the crystallization of all petroleum geologists ever fought in hot land of Tarim Basin during the "Ninth Five-Year Plan" period and the product of arduous work of comrades of Petroleum Industry Press. It is one important page of the hydrocarbon exploration history of Tarim Basin. After being published, this collection will undoubtedly be widely cared by domestic and foreign petroleum circles and bring them great interest. I hereby express my congratulation to the publishing of this collection.

Hydrocarbon exploration work in Tarim Basin started in 1950s and till now it has an over-50-year's history. In this course, the exploration personnel had suffered with many frustrations for various reasons but they also obtained rich materials, experiences and lessons. China National Petroleum Corporation, after approved by the State Council, organized a mass petroleum exploration campaign in April 1989, which was a firm and historic step for the large-scale overall hydrocarbon exploration in Tarim Basin. Meanwhile, the state also organized some "Eighth Five-year Plan" and "Ninth Five-Year Plan" brainstorm projects focusing on hydrocarbon exploration of Tarim Basin.

The content of the collection of *Petroleum Geology and Exploration of Tarim Basin* is full of the plentiful and substantial materials that have been obtained by a lot of petroleum workers through field geologic survey and drilling work around the basin in nearly 40 years and through continuous hard work for nearly 20 years after the Bureau of Geophysical Prospecting. This collection also contains the achievements that have been obtained through the practice and research for five years or more time based on the national key brainstorm research work during the "Seventh Five-year Plan" and "Eighth Five-year Plan" period; during this period, geologists had conducted hard but effective studies and practice on key regions and key series of strata. This course does obtain satisfying exploration achievements and initiate and deepen new theories and understandings. Especially, the hydrocarbon exploration work in complicated fracture zones and carbonate helps geologists in accumulating and enriching a series of theories, technologies and work methods such as large reservoir description and evaluation, seismic acquisition and processing, well logging, well completion and oil test and so forth.

During the "Ninth Five-Year Plan" period, 13 large/middle oilfields / gasfields and 27 gas-/oil-bearing structures available for industrial application in total have been discovered or proven. The large self-contained Kela-2 Large Gasfield was discovered and proven during this period, the proven geological reserves of natural gases of which are $2,840 \times 10^8 \text{m}^3$, while the rich natural gas accumulation zone was discovered in Kuche Depression, which establishing the resource foundation for the "West-East Pipeline Project". Later, Tahe-Lunnan Large Oilfield was ascertained. In recent five years, $5.905 \times 10^8 \text{t}$ (equivalent weight) of geological reserves of oil and gas have been

ascertained, including 1.908×10^8 t of geological reserves of petroleum, $3,997 \times 10^8$ m³ of geological reserves of natural gas. In 2000, the production of crude oil reached 440×10^4 t.

Through the exploration and research during the "Ninth Five-Year Plan" period, the understanding to petroleum geology of Kuche Foreland Basin has had an important breakthrough, and the theoretical foundation for petroleum geology has been preliminarily established for the large natural gas area in Kuche. In such aspects of research on Paleozoic marine carbonate hydrocarbon reservoir formation law, evaluation on major hydrocarbon source rock in Craton, research on development mechanism of marine carbonate and clastic reservoir, reservoir formation period and reservoir formation model and so on, some new progresses have been obtained, which has enriched the theory relating to marine petroleum geology, deepened the understanding on marine hydrocarbon distribution law of ancient cratonic basin. The deep research on petroleum geology of Tarim Basin ascertains the tectonic background of the Cenozoic basin of Tarim and the geological characteristics of hydrocarbon in basin groups in north edge of Tethys including Tarim Basin; it further concludes and perfects the occurrence and reservoir formation laws of hydrocarbons in Tarim Basin, evaluates and optimizes a large batch of favorable exploration areas, zones and destinations, determines the strategic development direction for hydrocarbon exploration of Tarim Basin and obtains a series of hydrocarbon exploration technologies and methods.

Especially, in Kuche foreland basin, geologists have innovatively applied the fault-related folding theory to establish 10 structure models in the fold-thrust structure zones of Kuche foreland basin and used it for interpretation and plotting of fine structures of seismic profile; the theory that states how coal is turned into hydrocarbon has been used to deeply analyze and systematically evaluate the hydrocarbon source rocks in the Triassic-Jurassic coal measure strata in Kuche foreland basin. It proposes the opinion that the coal measure strata hydrocarbon source rocks of wide distribution range, large thickness, high organic matter abundance, humus as main organic matter and high maturity are developing in Kuche foreland basin, while preliminarily understanding the petroleum geological characteristics of Kuche large gas area.

The brainstorm strength of exploration technologies is increased for a series of difficulties such as mountainous seismic exploration, drilling of high and steep structure, testing and evaluation on super-high pressure gas reservoir, recognition and prediction of carbonate hole, pore and seam-shaped reservoir, exploration of super-deep, low-amplitude thin sandstone oil reservoir, preliminarily establishing five sets of hydrocarbon exploration and evaluation technologies, which basically meet the current hydrocarbon exploration need of Tarim Basin.

This collection systematically concludes the exploration and research work that was carried during the "Ninth Five-Year Plan" period and by predecessors. Especially, it concludes the exploration practice and understandings obtained in past five years, including the understandings to existing exploration and basic research achievements and also including the conclusions of hydrocarbon occurrence law and application of new technologies and methods. Its contents are very rich and have a certain guiding significance to the future hydrocarbon exploration in Tarim Basin and other similar basin. However, we do not think that these achievements are very mature and perfect. On the

contrary, as the situations of Tarim Basin are very complicated, its exploration degree is relatively low, there are many difficulties unsolved and the exploration road is still very long, in our understandings there still are many unclear links and laws although there is a large progress. It is notable that the petroleum geologists in Tarim Basin are brave in practice and probing into new fields, they can work with perseverance for greater progress, and they are always summarizing experiences and taking lessons from practice, and they are brave to inspect their achievements in practice so as to deepen their understandings in practice. I believe that this collection will undoubtedly enrich the theories and practice of China's petroleum geology and play an important guidance role to the future exploration work.

As the hydrocarbon exploration in Tarim Basin has been continuously deepened and more progress has been obtained, our understandings will be closer to the reality and the original appearance of things. Through continuous efforts and exploration, our hydrocarbon exploration will undoubtedly have a forward leap. Till then, the hope of China's petroleum industry--Tarim Basin will produce more large oilfields and gasfields like Kela-2# and Tahe-Lunnan and get into a new peak stage of hydrocarbon reservoir, and Tarim Basin will really become the strategic base of China's petroleum industry. I am confident in this.

Finally, I sincerely hope that the publishing of this collection can play the role that offers a few commonplace remarks by way of introduction so that others may come up with valuable opinions, can in a certain degree meet the need of those experts in the national petroleum geology field who concerns with and support the petroleum exploration work in Tarim Basin, and can intrigue more people, so that there are more people to throw themselves into the hydrocarbon exploration relay race of Tarim Basin and to step into the charming and mystic Tarim Basin full of challenges.

Qiu Zhongjian

June 2003

前 言

波动是物质运动的基本形式。20世纪初至70年代，葛利普、白默伦、乌索夫、哈茵等著名地质学家在不同的研究领域内，从多个侧面论述了地壳运动的波动性。80年代初，施比伊曼在其专著《油气资源的定量预测》中提出了波的相互干涉可以形成不同的构造样式；同期，张一伟教授则提出波状运动是板块内部地壳运动的一种主要形式，它控制了凹陷的形成、演化、沉积相的发育、沉降中心的迁移和含油气富集区的分布。Maclaren教授曾指出，“地层学已被深深地卷入在全球范围内寻找可能有地内、太阳系和天文时间因素所导致的旋回机制”。20世纪80年代末至90年代初，缅斯尼高娃、施比伊曼创立了应用沉积盆地地层记录信息来识别周期波的方法，即通过研究小区的选择，对每个研究小区的原始资料进行统计、建立地层年代格架、恢复原始厚度，最终建立波动方程并进行方程的拟合与平衡检验的波动分析方法。波动分析的方法，使得我们在对地壳运动特点和油气聚集规律的认识和认知中又有了一种新的定量研究的理想工具。

塔里木盆地是由古生代海相克拉通盆地与中生代陆相前陆盆地组成的大型叠合复合型盆地。受多期构造活动的影响，塔里木盆地具有复杂的构造、沉积演化历史。多套源岩层、多期生排烃史和聚集史，多期形成的多种圈闭类型等特征，使塔里木盆地尤其是海相克拉通区油气藏分布规律异常复杂。经过数十年的科学研究，尤其是“七五”和“八五”国家科技攻关，对塔里木盆地的认识程度得到了极大的丰富。在塔里木盆地形成的大地构造背景、盆地沉积构造演化、油气源条件认识、圈闭发育特征以及油气成藏规律研究等方面都取得了一系列重大进展，在油气勘探实践中取得了显著成绩，实现年产原油500万吨的跨越。

但是，随着勘探程度的不断深入，制约勘探实践的科学问题也变得越来越为突出：①克拉通内几大不整合的形成过程及时空分布如何？不整合的时空迁移规律如何？隆起的剥蚀时间及剥蚀量如何？传统的地质方法可以解决最终剥蚀量，但对于剥蚀过程却无法回答。②对于多源多期成藏的古隆起，保存与破坏的矛盾无疑是制约油气赋存及其规模的关键。从油气聚集的角度看，隆起高部位最为有利；从后期保存的角度看，隆起高部位最容易受到破坏。波动地质学与石油地质学的结合，为寻找古隆起区油气“聚集”与“保存”的最佳场所，提供了极为有用的分析方法和研究工具。③众所周知的是，塔里木盆地经历了多旋回的发展演化，与之相应的是，在每一个大的旋回中都经历着油气的生排—运聚—调整的过程。波动地质学可以定量化演化周期，预测每一个“成藏旋回”的有利油气赋存区，有效地指导勘探实践。因此说，将波动地质学引入塔里木盆地，不仅有利于我们从更深、更广的角度来认识盆地的演化过程，同时对盆地发展过程中油气形成、演化、成藏以及后期改造等一系列问题的认识也将是一个有力的补充，必将带来塔里木海相克拉通区油气分布规律认识的升华。

本专著是在“九五”国家重点科技攻关项目《塔里木盆地石油天然气勘探（96-111）》下属一级专题《塔里木盆地沉积波动过程及对油气分布的控制作用》研究成果的基础上进一步上升提炼形成的。书中涉及的主要内容有：①应用磷灰石裂变径迹、镜质体反射率、泥质岩声波速率、地震层速度、地震构造剖面及波动过程分析等多种方法，定量恢复塔里木盆地主要构造抬升期地层剥蚀量分布；②应用铍同位素、氧同位素、碳同位素、微量元素、古生

物及沉积学分析等方法,系统建立塔里木盆地不同时期古水深演化剖面,恢复各层系古环境、古水深、古气候;③应用沉积盆地波动过程分析方法,对58口钻井进行单井波动过程分析并建立相应的波动方程,识别出塔里木盆地发育过程中的几级主要周期波,并进一步分析了这些周期的成因机制及其对盆地演化的控制作用;④应用全球海平面变化的研究成果,进行环满加尔地区基底沉降波动过程研究,并对塔北隆起、中央隆起及其次级构造单元的沉降特征进行比较分析;⑤应用地质历史中的米兰柯维奇旋回,通过对中央隆起带下志留统测井曲线进行小波分析,建立下志留统更为精细的年代格架,进行高频周期波分析;⑥通过对源岩热史、流体历史的综合分析,建立油气运移、聚集的基本格架,并与盆地演化的波动周期对应起来,建立油气成藏旋回的概念,实现对复杂的多旋回叠合复合型盆地油气地质条件认识有新的突破。

本书的编写分工为,前言及第一章由金之钧编写,第二章由王毅、金之钧编写,第三章由鲍志东、朱井泉编写,第四章由刘国臣、金之钧编写,第五章由吕修祥、金之钧、庞雄奇编写,最后由金之钧统稿。另外参加研究工作的还有严俊君、李京昌、刘银河、齐永安、胡斌、李红楠、范国璋、李范珠。

从“九五”国家攻关项目中的专题研究到本书的编写过程,始终是在张一伟教授的组织指导下完成的,在项目研究期间他曾两次深入塔里木现场指导并参加研究工作,为本项研究付出了大量心血;他甘为人梯、培养扶持年轻学者的精神与做法使我们终生难忘,为我们树立了学习的榜样。项目负责人梁狄刚教授、贾承造教授、顾家裕教授以及项目办公室张师本教授、姚慧君高级工程师、李良辰副教授在攻关的整个过程中给与了大力支持与指导。在研究过程中还得到了王鸿祯院士、马宗晋院士、李德生院士、蒋志教授、石宝珩教授、傅承德教授、关德范教授等专家的多方面指导。中油股份公司塔里木油田分公司胡云杨教授、王招明教授、王清华高级工程师、皮学军高级工程师等一大批现场工作的领导与专家给予了大力支持与帮助。石油大学(北京)盆地与油藏研究中心汤良杰教授等同事们给与了许多帮助,在书稿的整理过程中王嗣敏博士付出了大量的心血,在此谨致以衷心的感谢。

由于波动地质学涉及面广,与构造地质、石油地质学的结合尚处于探索阶段,虽经作者多方努力,但限于时间和水平,难免存在不妥或谬误之处,欢迎批评指正。

作者

2003年8月

Foreword

Fluctuation is the basic form for the movement of matter. From the beginning of the 20th century to the 1970s, the famous geologists like A.W. Grabau, R.W. Van Bemmelen, M.A. Usov and V.E. Khain have elaborated on fluctuations of the crustal movement from a number of angles in the different research fields. In the beginning of the 1980s, V. Shpilman drew the conclusion in his writing of "Quantitative Prediction of Oil and Gas Resources" that mutual interference of wavelet could form the different structural patterns. Meanwhile, Prof. Zhang Yiwei pointed out that wave motion is one of the main forms for crustal movement inside the plate, which controls formation of depression, evolution, development of sedimentary facies, migration of subsidence center and distribution of oil and gas accumulation zones. Prof. D. Maclaren once pointed out that "stratigraphy has been deeply involved in the possible cycle mechanisms worldwide caused by the earth, solar and astronomical time factors." From the end of the 1980s to the beginning of the 1990s, G.P. Myasnikova and V. Shpilman have created the method to use stratigraphic recorded signal of sedimentary basin for identification of the periodic waves, namely selection of the research subregion, which makes the statistical study of the original data of each research subregion, establishes stratigraphic time configuration, restores the original thickness and finally establishes the wave motion analysis method through fluctuation equation, simulation of the equation and balanced inspection. The method for analysis of wave motion enables us to have a new desirable tool for quantitative research on the characteristics of crustal movement and oil and gas accumulation law.

Tarim Basin is a large superposed composite basin shaped from craton basin of Paleozoic marine facies and foreland basin of Middle Cenozoic continental facies. Subject to the influence of multi-stage structural activities, Tarim Basin has the complicated structural and sedimentary evolution history. With multiple sets of source rock, multi-stage hydrocarbon expulsion history and multi-stage accumulation history, Tarim Basin is characterized with a variety of traps formed in various stages, making the distribution law of oil and gas reservoirs extremely complicated in the basin, cratonic zone of marine facies in particular. Based on the scientific study in the past few decades, the research projects in the "Seventh Five-Year Plan" and the "Eighth Five-Year Plan" periods have tremendously enriched the knowledge about Tarim Basin. Great progress has been made in the research on the ground structural background of the basin, the sedimentary structural evolution of the basin, the conditions for the oil and gas sources, the characteristics of trap development and the law for oil and gas reservoir formation. Remarkable achievements have been made in the practice of oil and gas exploration in Tarim Basin where the annual crude production reaches 5 million tons.

However, with the progress made in exploration, some technological issues impairing

the exploration practice have become increasingly prominent: (1) How about the formation process and space distribution of several large unconformities within the craton? What about the law for space and time migration for those unconformities? What about the denudation time and denudation volume of the uplift? The traditional geological method can settle the ultimate denudation volume but is unable to explain the denudation process. (2) As for the ancient uplift of multi-source and multi-stage reservoir, the contradiction between reservation and destruction undoubtedly holds the key to the oil and gas storage and scale. The high position of the uplift is most favorable from the angle of accumulation, but the high position of the uplift is most prone to destruction from the angle of later reservation. Combination of fluctuation geology with petroleum geology provides the extremely useful analysis method and research tool for search of the best places of oil and gas "accumulation" and "reservation" in the ancient uplift zone. (3) As it is well known, Tarim Basin has experienced the multi-cycle development and evolution. Correspondingly, it experiences the oil and gas sourcing-migration- adjustment process in each major cycle. Fluctuation geology can quantitatively determine the evolution period and predict the favorable oil and gas storage zone of each "reservoir-forming cycle," thus effectively guiding the exploration practice. Therefore, application of fluctuation geology for Tarim Basin not only enriches our knowledge about the evolution process of the basin but also help us know more about the series of issues concerning oil and gas sourcing, evolution, reservoir and later renovation in the development process of the basin. It will inevitably make us more clearly understand the oil and gas distribution law of marine Cratonic zone in Tarim Basin.

This book is written on the basis of the research results achieved from the topic of "Sedimentary fluctuation process of Tarim Basin and role in controlling oil and gas distribution," which is part of the study project of "Petroleum and natural gas exploration in Tarim Basin (96-111)," one of China's key research projects in the "Ninth Five-year Plan" period. The main contents involved in this book include: (1) A variety of methods, such as apatite fission track, vitrinite reflectance, politic rock acoustic velocity, seismic layer velocity, seismic structural profile and analysis of fluctuation process, are used to quantitatively restore the distribution of denudation volume during the main structural elevation in Tarim Basin. (2) Strontium isotope, oxygen isotope, carbon isotope, microelement, palaeontologic and sedimentologic analysis are used to systematically establish paleobathymetric variation profile at the different stages in Tarim Basin and restore the paleoenvironment, paleobathymetry and paleoclimate of various strata series. (3) The method for analysis of the sedimentary basin fluctuation process is used to analyze drilling of 58 wells for the single-well fluctuation process and establish the corresponding fluctuation equation. Some major periodic waves are identified from the development process of Tarim Basin. The genetic mechanism of those periods and its controlling effect on basin development are brought under further analysis. (4) The research results on the global sea level variation are used to study basement settlement

process of region surrounding Manjiaer and make comparison and analysis of the subsiding characteristics of Tabei Uplift, Central Uplift and their secondary structural units. (4) The Milankewiqi Convolution in the geological history is used to analyze the wavelet of Silurian logging curves left in Central Uplift zone and establish the more precise time configuration of Lower Silurian for analysis of high-frequency periodic waves. (6) Based on integrated analysis of source rock thermal history and fluid history, the basic configuration for oil and gas migration and accumulation is established to correspond to the fluctuation periods of basin development. The conception for cycle of oil and gas reservoirs is established to make breakthrough in the knowledge about the oil and gas geological conditions of complicated and multi-cycle superposed composite basin.

The preface and the first chapter of this book are formulated by Jin Zhijun, the second chapter by Wang Yi and Jin Zhijun, the third chapter by Bao Zhidong and Zhu Jingquan, the fourth chapter by Liu Guochen and Jin Zhijun and the fifth chapter by Lu Xiuxiang, Jin Zhijun and Pang Xiongqi. Jin Zhijun makes final examination of the whole book. The other participants involved in this research project include Yan Junjun, Li Jingchang, Liu Yinhe, Qi Yong'an, Hu Bing, Li Hongnan, Fan Guozhang and Li Fanzhu.

Organized and guided by Prof. Zhang Yiwei, this book is formulated on the basis of the special research topic listed in the scientific research project during the "Ninth-Five-Year Plan" period. Prof. Zhang has made trips to Tarim Basin twice to offer field guidance and personally participate in the research work, making great contribution to this research project and setting up a good example for young scholars. This research project has always drawn tremendous support and guidance from Prof. Liang Digang, Prof. Jia Chengzao, Prof. Gu Jiayu, Prof. Zhang Shibei, Senior Engineer Yao Huijun and Associate Prof. Li Liangchen. In addition, Academician Wang Hongzhen, Academician Ma Zongjin, Academician Li Desheng, Prof. Jiang Zhi, Prof. Shi Baoheng, Prof. Fu Chengde and Prof. Guan Defan also guide this research project. A large number of leaders and experts working on the field give their support and help of this research project, such as Prof. Hu Yunyang, Prof. Wang Zhaoming, Senior Engineer Wang Qinghua and Senior Engineer Pi Xuejun from PetroChina Tarim Oil Field Company. Gratitude is extended to Prof. Tang Liangjie and his colleagues at Basin and Oil Reservoir Research Center of Petroleum University (Beijing) and Dr. Wang Simin for their help to formulation of this book.

This book is open to any correction and opinions since some mistakes may exist owing to the short period of time for writing. In addition, a wide range of knowledge is involved in fluctuation geology and this subject is in its preliminary stage to be combined with tectonic geology and petroleum geology.

Author
August 2003

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