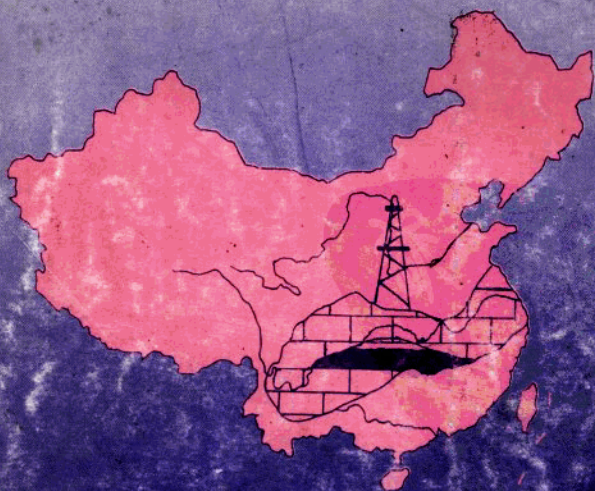


# 中国南方 海相碳酸盐岩油气勘查 研究论文集

欧庆贤 主编



江苏科学技术出版社

谨以此书献给曾参加  
支持和关心过中国南方  
海相碳酸盐岩区油气勘  
查国家科技攻关的朋友  
们！

欧石贤  
1993.10.

# 《中国南方海相碳酸盐岩油气勘查研究论文集》

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# 序

石油和天然气是宝贵的战略资源。新中国成立 40 多年来,广大石油地质勘查人员艰苦奋斗,勇于开拓,取得了许多重大成果,有力地促进了石油工业和祖国建设事业的发展。通过大量的勘查实践和科学研究,不断丰富和深化了反映我国实际情况的地质理论,提高了勘查技术能力,改进了勘查方法,培养了大批各类人才。但是,我国石油天然气的生产规模还远远不能满足国家经济建设和社会发展的需要。油气资源后备储量和后备基地严重不足,是不能更快增长产量的主要的制约因素。因此,尽快找到新的后备基地,增加探明储量,提高储采比,是地质工作的一项极其光荣而艰巨的任务。

油气地质工作,就其本身过程来说,是以先进的地质理论为指导,按照一定的模式和程序,进行正确的战略、战役部署、综合运用各种有效的技术手段和方法,在广阔的区域勘查基础上,寻找与评价油气远景区,发现油气田,探明储量,提供油气开发基地的过程。在整个工作中,理论的指导作用,方法技术的有效实施,始终是取得成功的关键因素。

国外大多数油气田是在海相地层中发现的,海相成油地质理论占据统治地位。我国中生代、新生代地层中广泛分布陆相沉积。在老的海相沉积地区,经过多次构造运动,地质现象极其复杂,工作条件十分困难。针对这种实际情况,我国老一辈地质学家提出了陆相生油及其他重要地质观点和理论,大大解放了人们的思想,坚定了陆相地区找油的信心。与此相应,通过引进和研制相结合,不断改进勘查方法和提高技术水平,有效地开展了大规模的陆相盆地油气勘查工作,发现了大庆油田等一系列重要油气田,使我国成为世界上重要的产油国之一。经过多年的反复实践,陆相生油理论及与之相适应的一整套方法技术,也得以进一步发展和完善。

近年来,地质工作大力加强油气勘查,在“四新”(新地区、新领域、新类型、新深度)方针指引下,除了继续东部老区的深入探索,加快西部新区的开拓和海上工作之外,又系统地开展了南方海相碳酸盐岩地区找油气的科技攻关,从理论上和方法技术上为推动这一领域的战略展开进行科技储备。本书收集的文章就是这一期间扬子海相碳酸盐岩地区油气勘探技术和评价研究攻关的若干重要成果。

我国南方海相碳酸盐岩分布广泛,有相当大的油气潜在远景,区内经济和交通比较发达,如能取得油气攻关的突破,将产生重大的经济效益,而且对全国海相领域的石油地质工作有巨大的促进作用。鉴于工作地区地质、地形条件的复杂和困难,攻关工作本着社会主义大协作精神,组成跨部门、跨单位的优势力量。在以往工作基础上,通过深入调查分析,明确攻关难点,确定了总目标和技术思路,运用系统工程思想,确立了多学科、多层次的众多专题组合。在实施过程中,又力图采用现代大科研管理方法,狠抓质量、效率和效果。经过 8 年的协同奋战,基本上建立起能够适应不同勘查阶段、不同地质条件和复杂地形条件的勘查技术系列,在本区展开工作;初步形成了扬子海相油气生成、聚集、保存、成藏的理论体系和新的找矿思路,同时还查明了一批圈闭,获得了几口发现井和许多油气显示,并取得了上扬子地区海相碳酸盐岩领域中天

然气勘探的新的有重要意义的突破,对整个扬子地区海相领域油气资源潜力作出了有科学依据的确切评估。科研和勘探密切结合,攻关工作取得了重要进展。由于这一课题的艰巨性,已取得的成果虽然还是初步的,但是,它已经明确地显示了应用新理论和高技术解决我国几代地质工作者梦寐以求的这一难题的前景。可以预期,只要我们树立长期坚持的思想,沿着不断实践、不断总结提高的路子继续走下去,新的更大的油气突破,是可以实现的。

本论文集包括新地质成果和新方法技术成果两部分,每个部分都具有丰富的内容。我希望论文集的出版,能够引起对南海相碳酸盐岩地区油气勘查研究工作的更多的关注、更大的支持和持续的科学实践,使这一新领域的理论认识和方法技术得到更好的推广应用,进一步深化和提高,克服前进中的困难,团结协作,为共同开创海相沉积领域油气工作的新局面而奋斗。

夏国治

1992年9月

## PREFACE

Oil and gas are taken as valuable strategic resources. Since the founding of the People's Republic of China over 40 years ago, vast numbers of petroleum geologists have been working hard and bold in opening up a new path for the development of the oil industry. As a result, numerous significant achievements have been made, and thus brought about a mighty advance in the oil industry as well as the construction of this country. Through innumerable practices in prospecting and scientific research, it enables the geological theory combined with the actual situation in China to have a steady improvement and get increasingly deepened, so that the prospecting method and technological level are consequently enhanced. And a large number of qualified professionals in different areas come to the fore after rigorous training. However, it's far from meeting the demand of national economic construction and social development in term of production size. Also, inadequacy of stored-up reserve and base for oil and gas resources are deemed the primary factors of restrictions, for a continued increase of production. Therefore, it is a most glorious but arduous task for geologists, which should include accelerating the pace of locating new base, increasing the proven reserves, and raising the reserve-recovery ratio.

As far as the operational procedures of geological exploration for oil and gas are concerned, the rule-of-thumb proved workable should involve: guiding by advanced geological theory; applying right deployment in strategy and campaign according to the proper mode and due procedures; utilizing the service-proven technical means and technique based on the vast regional surveys to search for and make evaluation of perspective oil-gas areas, discover oil and gas field, verify reserves and provide the story about establishing the base for oil and gas resources exploration. In the course of executing the undertaking, the role that the theoretical guidance plays and ensuring the efficient implementation of method and technique are always considered the key to success.

The majority of oil and gas fields overseas are discovered from marine formation. Hence, the genesis of oil in marine formation grounded on geological theory occupies a dominant position. The continental deposit had dispersed widely in Mesozoic and Cenozoic era, over China. As a consequence of tectonic movement that took place repeatedly in paleomarine depositional areas, the geological settings appear extremely complex, which creates a very difficult circumstances for geological surveyors. Targeted at such a situation, the Chinese veteran geologists advanced the theory of petroleum origin from continental facies and other concepts and presumptions of significance in geology, which are highly conducive to emancipate the public thinking and gain confidence of being capable of finding oil in the continental areas. For coordination, endeavour is made to integrate importation with development, which enables the exploration method and technological level to keep updating

and an extensive oil and gas exploration in continental basin could have been efficiently conducted. This results in the successful discovery of a series of major oil-gas fields, such as Daqing Oilfield etc. So China becomes one of the leading oil-producing countries in the world. Through many years of operation made in succession, the theory about genesis of oil in marine formation along with a whole set of methods and techniques suited to it also got further developed and perfected.

Of late years, geologic workers have given an energetic support to enhance the reconnaissance survey for oil/gas. Under the guideline of 4 NEWNESS (new prospect, new frontier, new type and new depth), in addition to the continued thorough investigation of the eastern area surveyed and speeding up the pioneering job in the new area of western China and offshore exploration, we have also carried out the tackling of key problem encountered while conducting oil-gas exploration in the carbonate areas of southern China in a scientific and systematic way. In so doing, it aims at gearing up the strategic preparedness of "Scientific stockpile" in theory as well as method. The papers collected in this book cover some major results achieved with regard to tackling the key technical problem come across during the oil-gas exploration in the marine carbonate areas of Yangtze and evaluation of the research conducted.

The carbonate rock disperses widely in the southern China. There are considerable potentialities of oil-gas in prospect. Generally speaking, it is a fairly developed area and transportation facilities there are good. If a breakthrough is made when tackling the key problem in finding oil-gas, positively it will produce economic result tremendously, thereby the petroleum geology operation nationwide in marine formation will be geared up immensely. In view of the complexity of geological and terrain conditions, and problems of the area surveyed, the key-problem-tackling job has been carried out in line with the spirit of making a large-scale socialist cooperation for pooling together trans-sectors as well as trans-units so as to make up a preponderate forces. Based on the work done previously and thorough investigation and in-depth examination conducted, what are the problems we have to look at when doing the "tackling" are presented. And the general goal and strategic considerations in technology are set and given. Moreover, by applying the philosophy of systems engineering, a combination of numerous special subjects which should involve with multidisciplinaries and multiadministrative structures has been established. In the course of implementation, we strive to adapt the method called "macro scientific management" which is populous, nowadays. It is characterized by its rigorous rules that have to be enforced for ensuring the quality, efficiency and desirable result.

After 8 years of valiant struggle, a series of technical setups tailored to different exploration stages, various geologic settings and complex terrains has been radically established. All of which contributes remarkably for conducting operation in this area. A theoretical system of genesis, accumulation, storage and pool built-up of oil and gas has been preliminarily formulated. A new thinking about ore-search is put forward. Meanwhile, a

number of traps are detected, several discovery wells drilled, and lots' of evidences of oil and gas obtained. Also, significant breakthrough has been newly made with regard to the gas prospecting in marine carbonate areas of the Upper Reach of Yangtze River. Furthermore, an assessment of the potentialities of marine oil-gas resources in the whole Yangtze area is appropriately made. I may well say that with the adherence to the guideline, research must be closely combined with exploration, the key-problem-tackling job has made much headway. The significant research project has reaped its first fruit, despite it is an arduous task indeed. However, it opens up before our eyes a good prospect in the sense that this long-standing hot potato which remains unsolved for generations among geologists could be resolved using new theory and high technology. We can anticipate that another breakthrough could yet to be made so long as unremitting efforts is to be put forth on a long-term basis and advances along "keep on practising", "sum up experiences" and "ensure further advancement" which are taken as accepted practice.

The SYMPOSIUM covers 2 parts, the geologic findings newly achieved and the new method /technique developed. Each of which has very substantial content. I hope that this publication will stir up profound interest, arouse much concern and draw even more ardent support and be assiduous in conducting scientific practice with regard to research on oil-gas exploration in the marine carbonate areas in southern China so that to help widen the application, deepen the cognition and keep updating of the new theory, method and technique being implemented in this new area. Try to surmount the difficulty to be encountered as we are forging ahead, carry forward the spirit of solidarity and coordination, and strive for jointly opening up a new prospect for conducting oil-gas exploration in the marine depositional areas.

**Xia Guozhi**

September 1992



# 前 言

## “不要近视无远谋”——陈毅

国家重点科技攻关项目——中国南方海相碳酸盐岩区油气勘查技术和评价研究已经艰难而有效地走完了8年的历程。通过实践，她使我们基本结束了长期以来对中国南方海相碳酸盐岩油气问题的争论，使一个广阔的新的找油气领域展示在我们面前。她真正拉开了在中国南方海相地层找油气的序幕，并在南方和北方都取得了令人鼓舞的新突破。

8年来，我们为南方海相碳酸盐岩油气勘探打下了坚实的科学基础，形成了新的技术，提出了新的理论，明确了新的方向，给出了新的评价，在上扬子地区取得了新的重大突破，从而坚定了开拓这一新领域必胜的信心。可以预料中国将会逐步转入一个以新领域为主体的找油气时期，其过程虽然可能缓慢，但其方向将不可逆转。相信通过努力和适当的投入，将会取得难以估量的效益。中国也将会为世界油气勘探科技的发展再一次做出重大贡献。

“七五”国家碳酸盐岩区油气科技攻关是“六五”攻关的继续，她具有鲜明的特点：综合研究着眼于扬子全区，对油气规律有更深刻的认识；方法技术着眼于高新，具有更全面、更综合的技术方法，有基础研究、实际应用和推广的价值；它不单是勘查，还进入勘探阶段，对解决问题的能力更精细、更准确，对油气有新突破。因此“七五”攻关的成功就意味着她的工作将在“六五”基础上，使中国的“广义海相地层找油气”工作（即油气探测的目标不是简单地局限于海相地层本身，而是以“大系统”观点探索与海相关联的油气）进入到一个能全面展开的新阶段。

今天，虽然人们可能不会再去争论中国海相碳酸盐岩区油气工作是不是有希望的问题，但却会在新情况下提出当前值不值得继续攻关，值不值得投入较大力量展开更全面工作的问题。人们对此认识会有较大差异的。

我们认为，攻关已开发出许多既适用于中国南方也适用于中国其他地区的技术。这些技术对南方碳酸盐岩油气的勘查，以及全国的油气勘查技术进步都起到十分重要的作用；攻关已初步形成具有中国特色的复杂海相地层领域的石油地质理论，在地质远景评价和成油气理论方面提出了具有科学依据的新颖的观点，使人们对碳酸盐岩地区的油气远景有新的看法和估价，促成了一个新的战略思想的形成，为今后在相当长时期内实现中国找油气从陆相领域向“广义的海相领域”转移做了理论和技术上的准备。假如目前有足够的资金支持，就能够以这些理论和技术为基础，把勘查工作更有效地推向前进，夺取更多有效的生产性成果。因此，攻关应当继续，工作应当展开。

在中国海相地层领域找油气是非常复杂的。很多特性和规律，要在实践中逐步认识，要走漫长艰苦的路，但要重申：“对这一新领域的工作应平稳加速地进行，不要停顿；要注意到勘探成败的关键在于方法技术的进步和经济效益的提高。随着工作的深入要尽量减少根据不足的

设想和推断,提供更多准确可靠的资料。这就有赖于技术上的进步。因而必须不断解决方法技术问题,并始终把它置于极其重要的地位。”

和“六五”攻关一样,出版这个论文集的目的也是希望使成果更好地为人们所了解并进而推广、应用,以促进新领域的找油气工作和将攻关坚持下去,促使中国“广义海相地层找油气工作”不断取得新突破。同时,这个集子也是对8年奋战、两度攻关的回顾与总结。

今天“七五”攻关已成过去,为攻关献身的同志的音容和精神,以及许许多多动人的事件将在我的脑海中永存,永远值得思念。借此机会我要再次向这些同志表示深深的敬意和谢意,也向顾功叙、朱大绶、朱夏、关士聪、斯坦·琼斯、郭宗汾等许多国内外曾对我们的攻关给以关心鼓励、帮助和支持的同事们、朋友们表示谢意和怀念。

最后,我还要对本论文集特意撰写的具有指导价值的两篇论文的作者孟尔盛、袁道先先生表示谢意。

欧庆贤

1992年9月

## FOREWORD

"BE CIRCUMSPECT AND FARSIGHTED, NO STRATEGIC MYOPY"

—Chen Yi\*

The research and evaluation of the technology on oil and gas exploration in the carbonate areas of southern China, one of the State key projects mandatory to be tackled, has been accomplished in eight years period of time. It has involved tremendous efforts and does have borne fruit. The practice has put an end to the long-lasting contention about the problem resulted from oil and gas exploration in the marine carbonate areas of southern China. This really opens up before our eyes a broad and new sphere in search of oil and gas. Indeed, it pulls open a prelude to detecting oil-gas from the marine formation in the southern China. In fact, more breakthroughs have been made in the attempt to discovering oil-gas in the southern and northern China.

Over the past eight years, we have laid a solid scientific foundation for the oil and gas exploration in carbonate areas of this country. With which novel technology is developed, new theory advanced and what we ought to strive for next pinpointed, re-assessment made, and yet another significant breakthrough achieved in the Upper Yangtze area. Absolutely, all of which helps strengthen our confidence for that, to explore a new realm is bound to success. Hence, we can anticipate that China will phase into an oil-gas exploration period with the domain newly found as its principal part. The progress of its implementation may be slow but the trend is irreversible.

We firmly believe that the outcome will be undoubtedly immeasurable as long as we work hard and throw ourselves duly into what we should carry out. That means China would make yet once outstanding contribution to the oil and gas exploration worldwide in terms of the scientific and technological development in this field.

The technologically tackling of the key problem cropped up while conducting oil-gas exploration in carbonate area, one of the projects mandatory to be accomplished by the State during the national 7th Five-Year plan period (1986-1990) is taken as a "follow-up" of that for the project left unfinished in the 6th Five-Year Plan period. But nevertheless, the latter has its own distinctive characteristics, such as the integrated research should be conducted with attention focussing on the whole Yangtze area so as to be able to better understand the regularity related to oil and gas; in developing technology, our endeavour is to bring forth something "advanced" and "new"; warmly encourage the practice of "all-roundedness" when doing researches; take more comprehensive view of the situation around when performing

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\* The late PRC Marshal and poet

exploratory activities; and try to be of well-groundness, being highly functional as well as strongly recommendable. The newly developed technique not only is to be instrumental to the reconnaissance survey but also should be implemental as entering the prospecting stage. And yet more meticulous care and stricter accuracy are required for resolving problems involved in this connexion so that more breakthroughs in the discovery of oil could be made. Just because of these, the achievements made during the 7th Five-Year Plan period indicate that based on the work done during the 6th Five-Year Plan period, the oil-gas exploration in marine formation (here referring to oil-gas exploratory target, not just limited to the marine formation itself, but actually to explore oil-gas in the marine-related areas from "macrosystem" point of view) has been, in a broad sense, led to enter a new phase during which the operation could be all-sidedly carried out.

Today, people may no longer have the interest to argue about that, i. e. is it a payable job to conduct oil-gas exploration in carbonate area of southern China? But the controversies, such as under the new challenges, is it worthwhile to go on working with the "key problem tackling", and will it be profitable to throw in strenuous efforts for carrying it out all-sidedly may evoke. For which it is still a highly controversial issue.

However, we think that as a result of the "key problem tackling" practice, numbers of technologies suited to the southern China and other parts of this country are getting developed, which have been playing a very significant role to help forge the oil and gas exploration in the carbonate area of the southern China, and propelling the technological advancement of oil and gas exploration nationwide. What's more, the "key problem tackling" does have helped formulate primarily a theory of petroleum geology of complex marine formation, which is incorporated with Chinese specific conditions.

In addition, some novel suppositions are put forward with regard to geological prospective value and theory of oil genesis. Since these concepts are scientifically based, so logically they should have provided us some new ideas and evaluation grounds on oil-gas prospective of carbonate areas. Broadly speaking, they are to help bring about a new strategic thought to pave the way theoretically and technologically for shifting the oil and gas detection from the continental formation to the marine one, which has to be realized over a long period of time. Based on the theory and technical expertise the exploratory work can be pushed forward tremendously and more efficiently, and more substantial result out of production can be achieved, provided that there is enough funds. So the assignment of "key problem tackling" should be by all means, continued and carried through in full swing.

It is generally deemed as an intricately involved job that to search for oil from the marine formation in China. Lots of characteristics and regularities are to be understood progressively and have to undergo a protracted and torturous path. However, I want to reiterate my view that is we must carry out the work assigned in this new sphere steadily but speedily and uninterruptedly. In the meantime, attention should be riveted to that the linchpin upon which success of failure depends lies in ensuring the advancement of method and technology and

raising the economic benefits. With the development of exploration in depth, we have to make best possible minimizing the poorly-grounded assumptions /inferences, and furnish as much as possible the accurate informations with fidelity assured. To this end, I should say the advanced technology is a MUST. Needless to say, we ought to keep on trying to find out the key to the problems left unresolved and place it on the top priority all the way long.

The intention of publishing this symposium is the same as what we did for The Progress Report published few years ago, which covered up the story of tackling the key project carried out during the 6th Five-year plan period(1981-1985). It is our hope that more people can share with us the achievement made so that enabling those interested to better understand it and disseminate it for widening its application; and serve as an impetus to detecting oil/gas in the new field so as to allow for the "key problem tackling" assignment not to be discontinued, and expecting to make breakthroughs one after another with regard to "finding oil and gas from the generalized marine formation of China". Also, this publication to be presented to our readership is a review of the eight years' strive and twice strenuous efforts made in the "key problem tackling" and it can be served as a reminder for our colleagues at home and abroad.

Today, a page recorded the success attained in tackling the key project during the 7th Five-Year plan period has been turned over. But the likeness and vigour of those who have devoted themselves in the drive, and innumerable historic feats, or epic deeds performed by them will always remain in my memory, which deserve a perpetual commendation.

Again, I would like to avail myself of this opportunity to extend my heartfelt respects and gratitude to them. All cannot be named here. I should, however, like to mention Prof. Gu Gongxu\*, Mr. Zhu Dashou, Prof. Zhu Xia\*, Prof. Guan Shicong, Dr. Stanley B. Jones, Prof. John T. Kuo (Guo Zongfen) whose keen interests taken in, great helps offered to and wholehearted support lent for the key project are most appreciated.

Finally, my sincere thanks should also go to Messrs. Meng Ersheng and Yuan Daoxian who wrote specially for this symposium two papers which are deemed highly instructive.

Ou Qingxian  
September 1992

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\* Deceased

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