准噶尔盆地东部背景区烃类微渗漏研究

□新疆石油管理局 □彭希龄 盛志纬 单金榜 著

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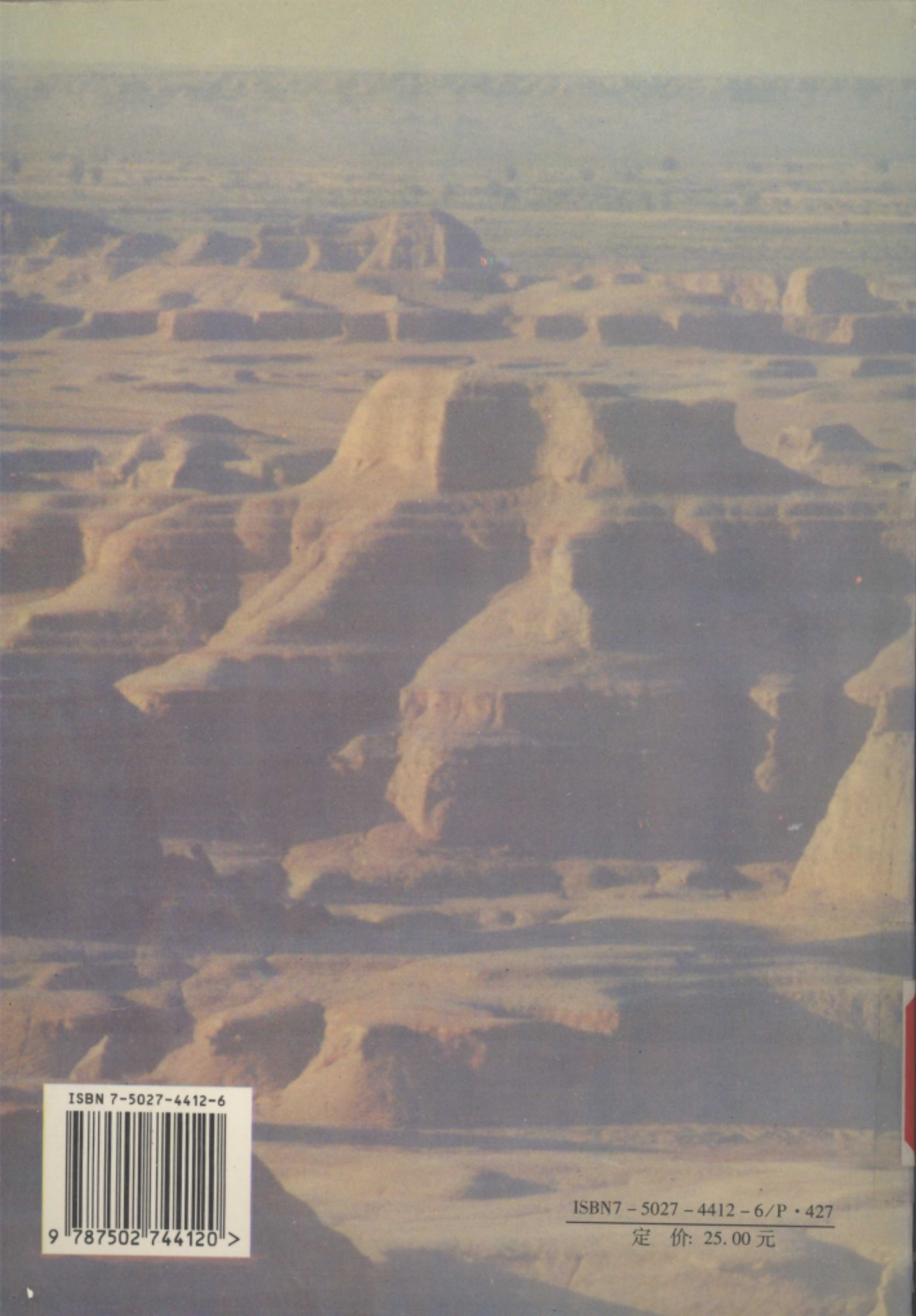

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Research of Hydrocarbon microseeping in Background Area of the Eastern Junggar Basin

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内 容 提 要

本书是继《准噶尔盆地东部烃类微渗漏研究》一书之后，在成藏不利的吉木萨尔凹陷中化探烃场背景区和强异常上对两口深200—600米全取心井孔所做的垂向化探研究结果。根据4口井垂向化探资料的对比研究，对准东地区油气化探烃场的形成机制、烃类微渗漏原理和不同条件下的烃渗漏特征都有新的见解和重要补充，并推荐了一些实用的新方法技术，可供从事油气化探的工作人员、生产管理干部、科研工作者和大专院校师生作重要参考。

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前　言

1988年～1990年的三年中，新疆石油管理局根据中国石油天然气总公司的要求，完成了准噶尔盆地东部阜康－吉木萨尔地区非地震勘探生产试验项目的多工种施工作业。一期工程所获得的成果表明，各种异常与已知的油气田无确定的相关关系。油气勘探界对此议论纷纷，褒贬不一。我们既未受异常与油气田的符合率高低所左右，也未因异常与油气田的相关性不肯定简单地予以否定，而是冷静地思索："这是为什么？"于是，我们在1991年～1993年又艰难地开展了二期工程的后续研究，希望能找出那些控制表象的更为深层次的本质规律，筛选出一些新的有用信息指标。首先是组织力量对一期工程的全部成果进行系统整理、区域成图、地质综合研究和应用效果分析，指出信息采集和资料处理中有待改进的多种问题，肯定了测得的化探烃场为客观存在，实事求是地评价了异常与油气田的对应关系，否定了应用效果不理想是因施工组织不好、工程质量不高所致的议论[1]。然而，对这种烃场是如何形成的却未找到答案，于是想到传统的油气化探理论中可能会存在一些还未被我们认识的重要问题，很有必要从反映机制上进行具体的深入研究，以揭示烃渗漏和烃场的形成及其与各方法工种成果间的内在联系，也就是还必须做一点"打破砂锅问到底"的笨工作。继而决定在区内最好的油田——北三台凸起北坡北16井断鼻油田内和北三台凸起近顶部的南坡非油气田区各钻一口深600m（实际为601.4m和601.7m）全取心的机制研究验证井，其一在油田区的激电异常内，另一则在非油气田区的激电场背景区，目的是验证激电法用于油气勘探的理论黄铁矿化机制和研究油气化探理论核心的烃微渗漏作用究竟如何。结果已详述于《准噶尔盆地东部烃类微渗漏研究》一书之中。二期工程的研究以大量翔实的资料和数据证实了烃类微渗漏作用的存在，参与渗漏的烃类不仅限于气态烃和液态轻烃，还有高碳数的正构烷烃和高分子杂环芳烃、胶质、沥青质等重组分。这些烃类肯定是来自地下深处，其中的高碳数烃是土壤中远比气态烃更不易逸散的地下油气信息，这就为开发新的油气化探检测方法开拓了思路。令人惊奇的现象是，不仅烃类的微渗漏作用存在于油气田上方和油气田以外的地区，而且还发现在某些特定条件下（如深部存在已被完全破坏了的古油藏残余）油田区外的渗漏强度还可以高于油气田内地区。因此，不能简单地根据烃异常有无和值的高低来判断油气藏的是否存在。这就可对本区烃场的特征作出较好的说明。后面这一点是与传统的油气化探理论不一致的，是对它的重要补充和完善。也对现行油气化探机制的理论、方法和解释原则，提出了许多迫切需要解决的问题，是一个促进。这无疑会对油气化探的发展产生积极影响。

由于这两口井虽然各自钻在油田内外，但却又同在一个有利的含油气区带之中，因而它们所揭示的一切只能代表含油气盆地（或拗陷）中的有利含油气区带内的烃渗漏状况，对背景区的烃渗漏特征如何，我们仍缺乏真正的了解。背景区之所以成为背景，当然也存在烃微渗漏作用。问题在于，是否仅限于渗漏的强度较低，与异常区仅是量的差别呢，还是也有其他不同、甚

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〔1〕彭希龄等。准噶尔盆地东部阜康——吉木萨尔地区非地震物化探试验研究。新疆石油管理局勘探开发研究院，1991。

至质的差异？这样，在二期工程成果即将付梓的时候，新疆石油管理局的有关部门和领导又采纳了我们的建议，毅然决定在准东工区的纯背景区，继续坚持开展烃类渗漏特征的研究。这就是1993年～1995年进行的第三期工程。该工程选择在紧邻北三台凸起东侧的吉木萨尔凹陷中心最深部位的区域化探烃场背景区和其东半部斜坡区上的水迁移烃场强异常内，分别各钻一口600m和200m深的全取心井，采样密度和分析检测项目仍按二期工程的模式，并将结果与JJ_1、JJ_2两井进行对比研究。于是，获得了《准噶尔盆地背景区烃类微渗漏研究》这份成果。这是1993年出版的《准噶尔盆地东部烃类微渗漏研究》一书的姊妹篇。在这份成果中，读者可以看到几点非常重要的新材料。其一是位于背景区的井下样品酸解烃总烃(平均)含量可以比有利油气聚集区带上的非异常范围为高。这种非异常范围的总烃含量一般也与区域背景值相近，但其内有时一些部位是工业油气田区。按照传统油气化探的理论逻辑，地下的有利油气聚集区带，虽不能全都是异常区，至少也应形成高背景区，然而事实却是异常区往往与有利含油区带不符，有利含油区带也不一定出现高背景。背景区的烃渗漏研究与此相符，证明以酸解烃值含量数值的高低大小圈定异常，既可以不反映地下油气田的分布现状，也不能大体圈定有利油气聚集区带的范围。准东区域油气化探的结果正是这样。其二，背景区与有利油气聚集区带上渗漏烃的组分有重大差别，具体表现在主峰碳位置和碳数分布范围的不同，背景区渗漏烃的高碳数组分明显增多。根据这两项参数，虽不能直接圈定油气田的位置，但有可能将背景区剔除在外，圈定有利含油气区带(也是这两项参数的异常带)的范围。这比传统油气化探方法是一个进步，拓展了检测范围，充实了解释内容。其三是渗漏烃的组分差异，主要表现在C_{25}以后从液态烃直到胶质、沥青质等馏分。这些是不可能用传统的油气化探方法(酸解烃、壤中气烃、K～V指纹法等)获得的，我们在本区研究中开发应用的冷溶烃等检测方法正适应了这种需要。

背景区和有利油气聚集区带渗漏烃组分的不同，是我们在本区烃类微渗漏机制研究中的又一重要发现。可以预见，传统油气化探方法单纯依据轻烃指标的数据大、小、高、低来划分背景区和异常的模式将会被突破，从而开创一条结合烃类组分的不同来识别背景区和异常的有利油气聚集区带的新途径，还可能将化探异常的解释、新方法和新技术的研究推向一个新阶段。

准东地区两次烃类微渗漏机制的研究说明，对于油气化探这样一门既有几十年历史、应用前景看好而又还不完善的技术，应当像对待其他许多技术一样，在引进、使用方法技术的同时，必须注意认真地总结经验，实事求是地考察效果，并及时地舍得花必要的代价开展反映机制的研究，对方法技术的立论基础进行本质的挖掘与鉴别，发展和开发优势技术，扬弃无效和不成立的方法，使其健康地更新换代，更快地在应用中趋近成熟，在生产中发挥应有的作用。其结果是事半功倍，以较短的时间、较小的代价，达到预期目的。可惜在现实生活中，人们总是喜欢急于求成，认为基础研究的周期长、离生产远、实用性小、投入不值得，不如拣现成方法用，即使功效不清，也宁可花大量的投资、时间和人力去反复引进、试用，作低水平重复，错过了发展机遇。开展油气化探反映机制的研究，是正本清源的大计和科学措施，只有花本钱、下功夫，在掌握了微渗漏烃特征与油气藏的内在关系的基础上，才能促进油气化探这门技术迅速获得新的发展，在油气勘探开发领域发挥应有的作用。

企业以效益为本，喜欢开发见效快的项目，一般对基础研究的投入持慎重态度，对有利油气区带内的研究如此，对背景区的研究更难上加难。二期工程的研究结果证明中国石油天然气总公司对项目经费的支持所具有的远见卓识。三期工程的研究结果同样证明必要的投入是值得的，新疆石油管理局的领导和有关部门能继续支持开展背景区的研究，的确是一个既有远见

又富魄力的举措。

本项目由新疆石油管理局地调处负责管理，项目负责人：彭希龄（顾问）、单金榜、李达曾。样孔的钻凿工程由李达曾负责实施，刘义新承担井孔地质监督和地质录井、样品采集。研究工程由单金榜负责管理，并特邀盛志纬作咨询和参与研究，管理局总工程师李立诚亦应邀作项目的地球物理顾问和项目实施指导，并审定和修改了本书部分章节。本书初稿撰写完毕后，由彭希龄统一修改定稿。样品分析主要由大庆石油管理局研究院有机地球化学室完成，中国石油天然气总公司研究院实验中心也做了少量样品分析。张玉兰、许怀先、李平科、宋孚庆、肖廷荣、李选、吴德廉、黄瑶和郑瑞新等同志帮助收集资料、处理数据、编图、打字、复印书稿和图件，梁大新和地调处研究所成果室帮助清绘图件，谨此一并致谢。

PREFACE

From 1988 to 1990, Xinjiang Petroleum administration bureau completed a multiple item nonseismic exploration test project in Fukang-Jimusaer area of the eastern Junggar basin according to the demand of China National Petroleum Corporation. The results of the project have not shown certain relationship between the various anomalies and the known oil and gas fields. That was talked about in petroleum exploration circles. But we were neither affected by the conformity of the anomalies to the oil and gas fieds, nor intended to refute the techniques for no certain relationship between the anomalies and the oil and gas fields. We turned the problem over and over in mind. In 1991-1993 we carried on the second project, and hoped to find out the essence through the appearence and to select and discover some new useful information and indices. Thus, we sorted out all the results of the first project, carried out regional mapping, comprehensive geological research and application effect analysis, pointed out some problems in information requisition and data processing, affirmed the objective existence of measured hydrocarbon field of chemical exploration, evaluated practically and realistically the relationship between the anomalies and the oil & gas fields, and illustrated that the unsatisfactory application effect was not caused by the bad organization and low quality of theoperation. But we did not find out the keyto the formation of such hydrocarbon field, and thusrealized that major problems might be presentin the traditional theory of chemical petroleum exploration and that it is quite necessary to further study chemical petroleum exploration mechanic in order to reveal the formation process of hydrocarbon seeping and hydrocarbon field and their relationship with the results from various methods and techniques. As a result, 2 full-coring wells of about 600m deep were drilled for testing and verifying the validity of theoretical pyritization mechanic of induced polarization method and hydrocarbon microseeping which is the kernel of chemical petroleum exploration theory. One was drilled in well Bei 16 fault nose oilfield (the best oilfield in the work area) in the northern slope of Beisantai bulge and within an induced polarization anomaly, the other was located in the southern slope of Beisantai bulge and within induced polarization field background in non-oilfield area. The results were described in details in the book "Research of hydrocarbon microseeping in the eastern Junggar basin". Research in the second project has demonstrated the existence of hydrocarbon microseeping with numerous data. Microseeping hydrocarbons are not only light gaseous and liquid but also heavy compounds such as high carbon number normal alkanes, high-molecular heterocyclic aromatic, resin and asphaltene. These hydrocarbons are undoubtedly from the deep underground. High carbon number hydrocarbons are more useful for they are more difficult to escape than gaseous hydrocarbonsl, which may open up a path for developing new chemical petroleum exploration and detection techniques. And the surprising phenomenon is that hydrocarbon microseeping exists not only above the oil &

gas field but also outside the oil & gas field, and the discovery is that microseeping intensity outside the oil & gas field is, under given conditions (e. g. destroyed paleo-pool residue in the deep), bigger than that inside the oil & gas field, Therefore, it is invalid to determine the existence of oil & gas pool merely by hydrocarbon anomaly, which disagrees to the traditional theory of chemical petroleum exploration and made a good explanation to the hydrocarbon field features in the work area. It is an important complement to the traditional theory of chemical petroleum exploration, and also put forward many urgent problems to solve in the theory, method and interpretation principle of the current chemical exploration mechnic, and will surely have a significant effect on the development of chemical petroleum exploration.

Although the two wells were drilled inside and outside the oilfield, respectively, they both located in the same favorable petroliferous zone, and thus reveal the microseeping of hydrocarbons within the favorable petroliferous zone in the petroliferous basin(or depression). As for background hydrocarbon seeping, we still do not understand really. Microseeping of hydrocarbons exists surelyin the background, but whether the difference between background and anomaly is in seeping intensity or essentially, we did not know. For this reason, Xinjiang petroleum administration bureau accepted our proposal upon the completion of the second project, and decided to do the further research of hydrocarbon microseeping in the pure background of eastern Junggar. That was the third project in 1993～1995. Two full coring wells, 600m and 200m deep, were drilled at the regional hydrocarbon field background in the deepest central part of Jimusaer sag adiacent to Baisantai bulge and the strong hydrocarbon field anomaly of water migration in the eastern slope of Jimusaer sag, respectively, Sampling interval and analysis items were the same as the second project, and the results were correlated to wells JJ_1 and JJ_2. Finally, we completed the work "Research of hydrocarbon microseeping in background area of the eastern Junggar basin", which is the companion volume of "Research of hydrocarbon microseeping in the eastern Junggar basin". In this work, readers will find a few pieces of very important information. First, total concentration(mean)of acidizing hydrocarbons in down hole samples of background can be bigger than non-anomaly in the favorable petroleum accumulation zone. In the non-anomaly area, the total hydrocarbon content is generally close to the regional background value, but sometimes industrial oil and gas fields exist somewhere. According to the theoretical logic of traditional chemical exploration of petroleum, favorable underground petroleum accumulation zones should form high background, to say the least, though not all of them form anomaly. The fact is, however, that anomaly does not correspond frequently to favorable petroliferous zone and favorable petroliferous zone does not form high background necessarily. The research of hydrocarbon seeping in the background demonstrates this point of view, and proves that anomaly confined by acidizing hydrocarbon concentration neither reflects underground oil and gas field distribution nor encloses the range of favorable petroleum accumulation zone roughly. That was demonstrated by the chemical exploration in the eastern Junggar. Second, the composition of seeping hydrocarbons in background is significantly different fron that in the favorable petroliferous zone, as shown in peak carbon number and the range of carbon number. In the background

area, hydrocarbon content of higher carbon number is increased clearly. Although we may not encircle directly the location of oil and gas fields from these two indices, we can get rid may of the background area at least and mark favorable petroliferous zone (anomaly zone of the two indices too). Clearly, this is a great leap ahead of the traditional chemical exploration of petroleum. The third is the composition difference of seeping hydrocarbons, as shown mainly in C_{25}^{+} (from liquid hydrocarbons to resin and asphaltene). These are not available by traditional methods of chemical exploration of petroleum (acidizing hydrocarbons, gas hydrocarbons, in soil, K-V fingerprint, etc.). Techniques developed in our research, such as cold-solvable hydrocarbons, will meet the demand.

Another important discovery in our research of hydrocarbon microseeping mechanic is that the composition of seeping hydrocarbons in the background is different from that in the favorable petroliferous zone. It is foreseeable that the traditional techniques of chemical petroleum exploration will be broken through, and newways of distinguishing the background fromanomaly representing favorable petroliferous zone by combining compositional difference of hydrocarbons will be developed, thus carrying the interpretation of chemical anomaly and the research of new methods and techniques to a new stage.

The two researches of hydrocarbon microseeping mechanic of the eastern Junggar have illustrated that we must take the chemical petroleum exploration techniques, which are decades years old, imperfect and bright in future, seriously like many other techniques; summing up experience seriously, testing and judging the results practically and realistically, paying necessary price in time to carry mechanic study, excavating and differentiating theoretical base of methods and techniques, developing and exploiting dominant techniques, and getting rid of invalid and untenable methods while introducing, using methods and techniques in order to make them renewed and replaced healthily, tend to mature in application, and play a reasonable role in production Only by that can we get twice the result with half the effort and achieve the expected goal with shorter time and less cost. Be careful to avoid large investments, long time and manpower for repeated introduction and low level repetition and losing the opportunity for development. Carrying out the research of chemical petroleum exploration mechanic is a thorough-going matters and scientific measure. Only based on a good command of the inner link between microseeping hydrocarbon features and oil and gas pools will chemical petroleum exploration technique get a new and rapid development.

The significance of the test and follow-up research in the eastern Junggar is far beyond the eastern Junggar. The achievements will have a profound and lasting influence on the deepening of chemical petroleum exploration theory and technical innovation. The enlightenment from the chemical petroleum exploration in the eastern Junggar is that it is certain to obtain rich repay from honest engagement.

There still exist a series of technical problems for successors to solve in whether or not we can and how to encircle oil and gas fields based on the theoretical development and technical innovation of chemical petroleum exploration.

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