

中国含油气裂谷盆地构造

TECTONICS OF PETROLIFEROUS RIFT BASINS IN CHINA

张功成 刘 震 等著

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内 容 提 要

本书将我国自东北北端漠河到南海的中—新生代裂谷分为七大裂谷区,并将这七大裂谷区分为三大类四小类,即陆内裂谷区(分地幔柱发育型、无地幔柱发育型)、活动大陆边缘裂谷区和被动大陆边缘裂谷区。笔者等研究发现裂谷构造具多样性,地幔柱发育型陆内裂谷区是大油气区形成的优势区,其核心部位的盆地油气最富集,地幔柱发育的大陆边缘的凹陷油气也富集。

本书可以供石油天然气地质人员、勘探研究人员或其他相关专业人员参考。

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前 言

我国含油气裂谷盆地主要分布在大兴安岭—太行山—武夷山以东的大陆和毗邻海域,形成于中、新生代,自北而南分为“七段”,即东北裂谷区、渤海湾裂谷区、南华北裂谷区、中秦岭地块裂谷区、下扬子地台裂谷区、东海裂谷区和南海裂谷区。裂谷系总体走向北东—北北东,其间被近东西向造山带、深大断裂等阻隔,如燕辽造山带、西安—郑州—济南隐伏断裂带、北秦岭造山带、南秦岭造山带、南岭造山带和南海北缘滨海大断裂带等。上述七个裂谷区裂陷程度和演化有很大差别。这七大裂谷区分三大类四小类,即陆内裂谷区(分地幔柱发育型、无地幔柱发育型)、活动大陆边缘裂谷区和被动大陆边缘裂谷区。

裂谷区类型对裂谷盆地的油气富集性、凹陷的油气富集性以及大型油气田形成具有控制作用。不同类裂谷区和同一类裂谷区的不同部位其油气资源潜力差别巨大。

陆内地幔柱卷入型裂谷区的核心部位油气潜力最大。中国东北裂谷区、渤海湾裂谷区及中秦岭地块裂谷区属于陆内地幔柱卷入型裂谷,拉张强度较大,地壳被强烈“拉薄”,最薄的地方残余厚度不到 20km,减薄的厚度达 10km 以上,幅度比喜马拉雅山的高度还要大,形成大型裂陷区。前两个裂谷区已发现石油储量接近或超过 $100 \times 10^8 \text{t}$, 剩余勘探潜力依然很大。中秦岭地块裂谷区形成小而肥的凹陷。下扬子裂谷区、南华北裂谷区属于没有地幔柱卷入的裂谷区,裂谷强度低,地壳拉张因子很小,地壳厚度没有显著减薄,仅在局部形成深断陷,后裂谷期地层厚度比较薄,至今油气发现较少或没有发现。

东海裂谷区属于活动大陆边缘裂谷区,局部地幔柱发育,油气富集。

南海北部盆地属于被动大陆边缘裂谷区,局部地幔柱发育,油气富集。

裂谷区是我国重要的石油生产基地或潜在的油气生产区。但裂谷区之间油气资源潜力差距很大,长期以来备受关注。同一裂谷区内部不同盆地(或拗陷)间差别也甚大。上述裂谷区将来也是我国油气主要增储上产区域,解析裂谷区及其富油气盆地构造与成藏的深层次联系,在理论上和实践上都非常有意义。

近年来我国东部裂谷大区油气勘探又取得了长足的进展,新领域勘探不断取得突破,新地区如海拉尔盆地、渤海湾盆地南堡凹陷、黄河口凹陷、莱州湾凹陷、珠江口盆地白云凹陷都发现了大型油气田;新层系进展更为显著,如松辽盆地深层裂谷期火山岩地层、渤海湾盆地渤中凹陷周缘新近系、泌阳凹陷浅层新近系等都有领域性新发现;新类型在二连盆地、下辽河拗陷西部、济阳拗陷、苏北盆地和江汉盆地等都有重大进展。在以上领域发现了渤海蓬莱 19-3 等大油田群、南堡大油田、荔湾 3-1 大气田、庆深气田等一批骨干油气田,为东部裂谷盆地油气的储量增长和稳产提供了坚实的物质基础。

我国东部陆地及海上含油气盆地目前处于中等勘探程度,尚有很大勘探潜力。从裂谷区类型控制的角度分析各油气区、盆、洼、组合、构造带、圈闭等各层次的新领域,拓展老领域,可以提高我国油气资源自给率、深化中国沉积盆地理论。笔者等根据构造演化的阶段性和活动性及其差异性分析了我国东部及海上主要油气区的成藏特征。

本书各章撰写分工如下：前言由张功成、刘震撰写；第一篇第一章由张功成撰写；第二篇第二章由张功成、朱德丰撰写，第三章由张功成、朱德丰撰写，第四章由张功成、梁慧社撰写，第五章由刘震撰写，第六章由张文朝撰写，第七章由张功成、张晓东、朱德丰撰写；第三篇第八章由张功成撰写，第九章由张功成、何仕斌撰写，第十章由张功成撰写，第十一章由刘震撰写，第十二章由刘丽芳撰写，第十三章由张文朝撰写，第十四章由王秀林撰写；第四篇第十五章由张功成、吕锡敏撰写，第十六章由金晓辉撰写，第十七章由张功成撰写；第五篇第十八章由黄金山撰写；第六篇第十九章由刘彦撰写，第二十章由张功成撰写；第七篇第二十一章由张功成、王鹏、刘志峰撰写，第二十二章由王鹏、赵志刚、张功成、张锦伟撰写，第二十三章由熊斌辉、张喜林、张锦伟、王春红、杨海长撰写；第八篇第二十四章由张功成、谢晓军、刘世翔、王一搏、董伟撰写，第二十五章由李春荣、张功成、徐建永、赵志刚撰写，第二十六章由张功成、刘志峰、王鹏撰写，第二十七章由张功成、钟锺、沈怀磊、郭瑞撰写，第二十八章由王彦、何将启撰写；跋由张功成撰写。

在笔者等从事与本书相关的研究过程中，得到西北大学、中国石油大学（北京）、中国地质大学、北京科技大学、中国海油、中国石油、中国石化等相关单位的支持，得到中国科学院李德生院士、孙枢院士、戴金星院士、张国伟院士、贾承造院士、舒德干院士、中国工程院翟光明院士、童晓光院士、康玉柱院士、马永生院士、蔡美峰院士、赵文智院士等的指导与鼓励，在此一并表示衷心感谢。

Tectonics of Petroliferous Rift Basins in China

Zhang Gongcheng Liu Zhen *et. al.*

Petroleum Industry Press

Foreword

The Mesozoic to Cenozoic rift region of China is mainly distributed onshore and offshore in the east of Greater Khingan Mountains-Taihang Mountains-Wuyi Mountains, which was divided into seven parts: Northeast rift region, Bohai Bay rift region, Southern North China rift region, Middle-Qinling Block rift region, Xia Yangtze platform rift region, East China Sea rift region and South China Sea rift region. The rift region is characterized by NE-striking to NNE-striking, which was separated by orogenic belt and deep fault that striking EW, such as Yan-Liao orogenic belt, Xi'an-Zhengzhou-Jinan blind fault belt, north Qinling orogenic belt, south Qinling orogenic belt, Nanling orogenic belt and littoral deep fault in north South China Sea. The seven type of rift regions show great differences in rift intensity and basin evolution, thus, were classified as three major types and four subsections including intra-continental rift region (which was subdivided as mantle-plume originated and non-mantle plume originated), active continental margin rift region and passive continental margin.

The type of the rift region dominated the accumulation of hydrocarbon in rift basins and sags, in reservoir-seal assemblages and in structural zones, it also controlled the formation of the giant oil and gas field. Different types of the rift region and the different positions of the same type can show a great difference in hydrocarbon resource potential.

Intra-continental mental-plume originated rift region has the greatest hydrocarbon resources in its core area. Northeast rift region, Bohai Bay rift region and Middle-Qinling Block rift region was classified as Intra-continental mental-plume originated rift region with great rifting intensity, when the crust of the earth was significantly attenuated to thinner than 20km in the thinnest part to form the giant rift region. The decreasing of the crust was more than 10km, which is beyond the altitude of the Everest. In former two rift regions, more than 10 billion tons of reserve has been discovered with still a great quantity of yet to find. The Middle-Qinling Block rift region developed many small but hydrocarbon rich depressions. While Xia Yangtze platform rift region and Southern North China rift region were classified as non-mental-plume originated rift region with modest rifting intensity and crust attenuation, only developed deep rifting in limited part of the region and resulted in a modest petroleum discovery.

East China Sea rift region was classified as active continental margin rift region, while South China Sea rift region as passive continental margin rift region with more than 1 billion tons of petroleum reserve equivalent.

Rift regions are important oil production bases or potential bases for China. The great differences have attracted many attentions among the hydrocarbon potentials in different types of rift region. The different basins (or depressions) among the same types of the rift region

also differed a lot in petroleum reserves that have been discovered. The rift regions mentioned above would also be the important area for reserve and production growth, thus, to analyze its relationship with basin structure and hydrocarbon accumulation has both the theoretical and practical significances.

Recently, the petroleum exploration in rift regions of east China has made much progress, and made many discoveries in new ventures such as Hailer basin; Nanpu sag, Yellow-River-Mouth-Sag and Laizhou Bay sag in Bohai-Bay-Basin; and Baiyun sag in Pearl-River-Mouth-Basin. The exploration in new stratigraphy was also fruitful, such as the deep volcanics in Songliao basin, the Neogene in the margin of Bozhong sag in Bohai-Bay-Basin, shallow Neogene in Qinyang sag. New ventures are also successful in Erlian basin, western Lower-Liaohe sag, Jiyang sag, Subei basin and Jiangnan basin. The discoveries such as PL19-3 oil and gas field group, Nanpu oil field, LW3-1 gas field, Qingshen gas field and other discoveries significantly increased the reserves and the productions of the rift basins in east China.

The petroleum exploration in onshore and offshore east China has only reached the middle exploration density with a big hydrocarbon potential. From the view point of the petroleum significances of the different types of the rift region, to analyze the new venture of different oil fields, basins, sags, plays, and prospects can deepen the sedimentology theories, and have big significances on the national energy security. The hydrocarbon accumulation characteristics of onshore and offshore east China were analyzed by the different stages, different activities of the basin evolution.

The book was a success of team work. Foreword was written by Gongcheng Zhang, Zhen Liu, chapter 1 was written by Gongcheng Zhang, chapter 2 and 3 was written by Gongcheng Zhang and Defeng Zhu, chapter 4 was written by Gongcheng Zhang and Huishe Liang, chapter 5 was written by Zhen Liu, chapter 6 was written by Wenzhao Zhang, chapter 7 was written by Gongcheng Zhang, Xiaodong Zhang, Defeng Zhu, chapter 8 was written by Gongcheng Zhang, chapter 9 was written by Gongcheng Zhang, Shibin He, chapter 10 was written by Gongcheng Zhang, chapter 11 was written by Zhen Liu, chapter 12 was written by Lifang Liu, chapter 13 was written by Wenzhao Zhang, chapter 14 was written by Xiulin Wang, chapter 15 was written by Gongcheng Zhang, Ximin Lv, chapter 16 was written by Xiaohui Jin, chapter 17 was written by Gongcheng Zhang, chapter 18 was written by Jinshan Huang, chapter 19 was written by Yan Liu, chapter 20 was written by Gongcheng Zhang, chapter 21 was written by Gongcheng Zhang, Peng Wang, Zhifeng Liu, chapter 22 was written by Peng Wang, Zhigang Zhao, Gongcheng Zhang, Jinwei Zhang, chapter 23 was written by Binhui Xiong, Xilin Zhang, Jinwei Zhang, Chunhong Wang, Haichang Yang, chapter 24 was written by Gongcheng Zhang, Xiaojun Xie, Shixiang Liu, Yibo Wang, Wei Dong, chapter 25 was written by Chunrong Li, Gongcheng Zhang, Jianyong Xu, Zhigang Zhao, chapter 26 was written by Gongcheng Zhang, Zhifeng Liu, Peng Wang, chapter 27 was written by Gongcheng Zhang, Kai Zhong, Huailei Shen, Rui Guo, chapter 28 was written by Yan Wang, Jiangqi He, postscript was written by Gongcheng Zhang.

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