

林玉祥, 孟彩, 韩继雷, 等. 华北地台区古近纪—新近纪岩相古地理特征[J]. 中国地质, 2015, 42(4): 1058–1067.

Lin Yuxiang, Meng Cai, Han Jilei, et al. Characteristics of lithofacies paleogeography during Paleogene–Neogene in the area of North China platform[J]. *Geology in China*, 2015, 42(4): 1058–1067(in Chinese with English abstract).

华北地台区古近纪—新近纪岩相古地理特征

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摘要:华北地台区古近系—新近系在渤海湾盆地非常发育,在南华北地区也有较大厚度,而在鄂尔多斯盆地则不甚发育,仅在西北部有少量沉积。渤海湾盆地古近纪以断陷型沉积为主,主要为滨浅湖相沉积,物源来自多个方向,如北部的燕山褶皱带、西部的太行山隆起、南部的鲁西隆起、东部的辽东隆起区以及盆地内部的沧县隆起和埕宁隆起等。南华北地区古近纪发育大小不一多个沉积中心,以河流相沉积为主;鄂尔多斯盆地古近纪仅在西北部出现沉积,发育河流相,缺失古新统一始新统沉积。新近系沉积区主要位于渤海湾盆地、南华北地区以及鄂尔多斯盆地外围的地堑中,主要为河流相和滨浅湖相沉积。新近纪早期渤海湾盆地大面积隆升,导致湖盆收缩,部分地区遭受剥蚀夷平,中晚期盆地整体形成统一坳陷,主要为河流相沉积,局部发育滨浅湖相;南华北地区进入裂谷期后坳陷发育阶段,大面积接受沉积,主要发育河流相沉积。华北地台区西部沿鄂尔多斯盆地周缘形成了一套以河流相与滨浅湖相为主的山前盆地沉积。华北地台区古近纪—新近纪油气的有利勘探区域为渤海湾盆地。

关键词:华北地台区;古近系—新近系;沉积相;古地理;有利勘探区域

中图分类号:P534.61 **文献标志码:**A **文章编号:**1000-3657(2015)04-1058-09

Characteristics of lithofacies paleogeography during Paleogene–Neogene in the area of North China platform

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Abstract: Paleogene–Neogene strata in the area of North China platform is very thick in Bohai Bay basin, but relatively thin in southern North China. In the Ordos basin, however, Paleogene–Neogene strata are only developed in northwest area. During Paleogene, the main sedimentary type in Bohai Bay basin was rift-type deposition and the main sedimentary facies were shore–shallow lake, whose source came from multiple areas, such as Yanshan fold belt in the north, Taihang Mountain uplift in the west, Luxi uplift in the south, Liaodong uplift in the east and Cangxian uplift and Chengning uplift in the interior of the basin. The

收稿日期:2014-06-23; 改回日期:2014-10-07

基金项目:国家自然科学基金面上项目(41172108)、国家油气专项“十二五”课题(2011ZX05033-04, 2011ZX05004-01) 及中国石油“十二五”科技攻关课题(2011A-0203)联合资助。

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southern North China was divided into many depressions with different sizes during Paleogene, with the development of sediments of fluvial facies. During Paleogene, the deposition only occurred in the northwest of Ordos basin, where fluvial sediments were developed. During Neogene, sedimentary zones were mainly located in the Bohai Bay basin, southern North China and the peripheral graben of Erdos basin, mainly with the development of fluvial facies and shore-shallow lacustrine facies. Large areas of Bohai Bay basin were uplifted during early Neogene, leading to the shrinkage of the lake basin and the denudation of parts of the areas. During the mid-late Neogene the basin formed a unified depression, the sedimentary facies were mainly fluvial facies and locally shore-shallow lacustrine facies. Southern North China entered into the depression development stage after rifting during Neogene, when large areas accepted deposition and developed fluvial facies. The western region along the periphery of the basin of Ordos formed a set of fluvial facies and shore shallow lake facies foreland basin deposits. Favorable exploration region of oil and gas was Bohai Bay basin during Paleogene-Neogene.

Key words: North China platform; Paleogene-Neogene; sedimentary facies; palaeogeography; favorable exploration region

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华北地台区古近系—新近系具有十分丰富的油气资源,探明石油地质储量愈 100×10^8 t,高峰年产量超 6000×10^4 t,其中以渤海湾盆地资源潜力最大^[1-2],且油气资源探明率不到50%^[3]。为了更快、更准确地找到油气资源,需要正确地认识地层岩性与展布、沉积相类型及古地理特征。从前人的研究成果来看^[4-10],对各局部地区或单个盆地(拗陷)研究较多,而缺乏针对华北地台区全区系统的总结和分析,对古近纪—新近纪岩相古地理宏观特征与有利相带展布规律认识还不够深入。本文以华北地台区古近纪—新近纪为研究体,系统总结了岩相带展布规律和古地理特征,对本区下一步油气勘探具有一定指导作用。

1 地层划分及其特征

1.1 地层划分与对比

按照地层多重划分对比原理,依据古近纪和新近纪各顶底界线标志,对各岩石地层单元的地质时代进行了框定,建立了地层划分和对比格架(图1~2)。区内大部分地区古近系和新近系界线明确,采用沉积旋回、岩性组合和沉积速率等方法,结合前人研究成果,采取最合理的地层划分方案,较好地完成了全区古近系—新近系地层划分与对比。

通过各露头 and 钻井地层沉积相柱状图来看(图3~5),华北地台区古近系在渤海湾盆地最为发育,在南华北地区也较发育,而在鄂尔多斯盆地不甚发育,仅出露于盆地的西北部,盆地内缺失古新统一始新统^[11]。新近系仍在渤海湾盆地最厚,其他盆

地较薄或缺失,在鄂尔多斯盆地周围形成了多个地堑,沉积了砂岩、砾岩组合,盆地内部和其他地区很少见。

1.2 岩性与展布特征

华北地台区古近纪—新近纪沉积中心位于渤海湾盆地。古近纪于渤海湾盆地沉积了厚逾5000 m的泥页岩、粉砂岩、砂岩、含砾砂岩组合,形成了该盆地最重要的含油气层系,包括孔店组、沙河街组和东营组^[12-15]。孔店组一段为棕红色泥岩、砂岩,孔二段为深灰色泥岩、夹煤层,孔三段为棕红色泥岩,孔店组三个段构成一个完整的沉积旋回^[16]。沙河街组广泛发育,与孔店组不整合接触,主要岩性为灰—深灰色泥岩、粉砂岩、油页岩等,是重要的含油气地层。东营组以灰色泥岩为主,其次为紫红色泥岩、砂岩、含砾砂岩不等厚互层。渤海湾盆地新近系包括馆陶组和明化镇组。馆陶组广泛分布于华北平原地层区,岩性为一套灰白色砾状砂岩、细砂岩及棕红色泥岩层间互沉积,厚度410~1100 m。明化镇组以土黄、棕红色泥岩、砂质泥岩与灰白色砂岩为主,明化镇组在各地厚度变化不大,一般600~800 m。

鄂尔多斯盆地古近系仅有少量沉积,岩性以砾岩、砂岩、杂色粉砂岩与泥岩不等厚互层,局部夹白云质灰岩。渭河分区尚未发现古新统,始新统。红河组岩性以河湖相紫红色泥岩为主,与砂质泥岩及细砂岩互层,底部为砾岩,顶部砂岩增多,厚度166.1~820 m。渐新统可分为白鹿原组、甘河组。白鹿原组为河湖相灰白色粗、中粒砂岩夹紫红色泥岩或灰黄色砂岩与褐色泥质砂岩互层,厚度43~785

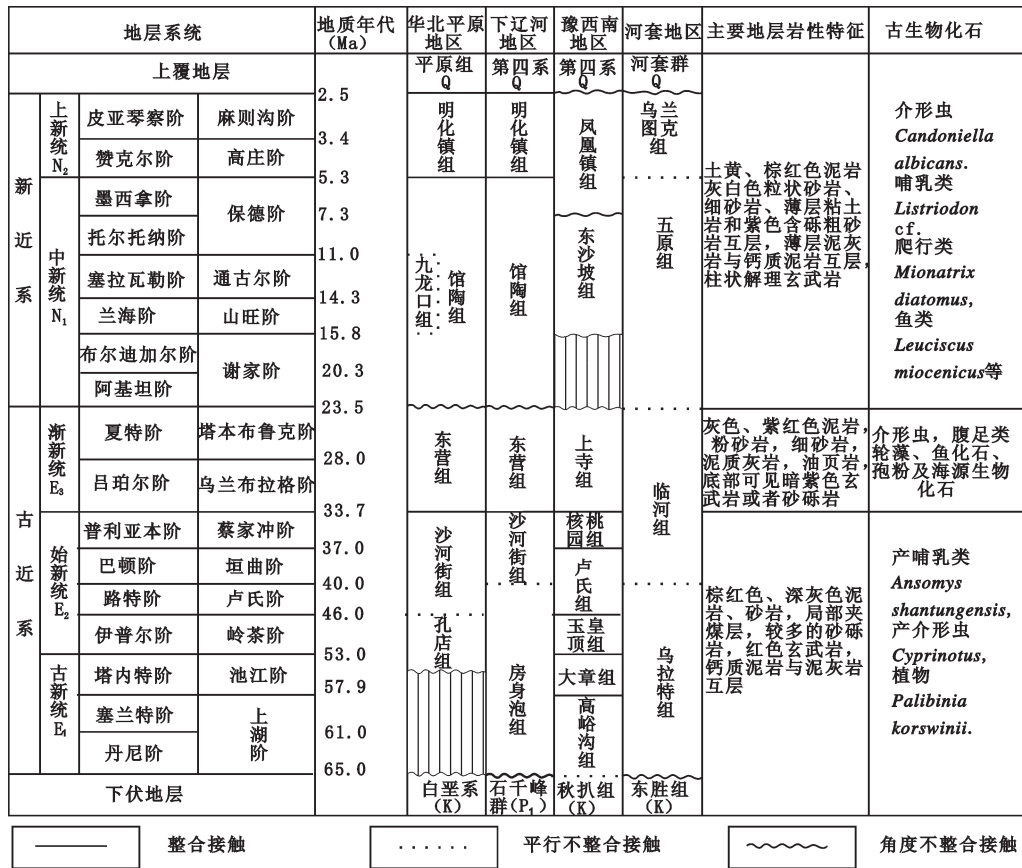


图1 华北地台区古近系—新近系地层划分对比图
Fig.1 Classification and correlation of Paleogene-Neogene strata in the area of North China platform

m。甘河组为灰白色含砾中-粗砂岩、砂砾岩，与褐灰色含砾泥质岩互层，夹细砂岩，顶部泥质岩夹炭质页岩及煤线，厚度401.21 m^[17]。鄂尔多斯盆地中新统广布全区，由棕红色碎屑岩、泥岩组成。上新统保德组岩性主要为棕红色粘土岩，富含钙质结核。底部有砂岩，局部含石膏矿。

南华北地区古近系主要岩性为棕红色不等厚泥岩、砂岩互层，底部主要为砂砾岩，上部夹有数量不等的暗色泥岩，在定远凹陷暗色泥岩及膏岩层较为发育。济源—黄口断陷内岩性主要是含膏盐的红层，分布在东西向断陷内。开封坳陷暗色地层较薄，多为红色、粗粒沉积，厚约3000 m^[18-20]。

2 沉积相特征

古近纪古新世—始新世沉积中心移至渤海湾盆地，另外南华北地区、南阳盆地等地也有沉积。鄂尔多斯盆地没有古近系古新统一始新统的沉

积。其西部的河套盆地、银川盆地发育滨浅湖相。六盘山盆地发育河流相、滨浅湖相。渭河地堑、南阳盆地以及南华北地区诸盆地均以河流相为主，局部发育滨浅湖相、深湖—半深湖相和湖相三角洲相。鲁西的成武盆地、平邑盆地、汶泗盆地发育滨浅湖相。柳河盆地发育深湖—半深湖相。渤海湾盆地沉积较厚，主要发育滨浅湖相，其次为深湖—半深湖相、河流相、冲洪积扇相和三角洲相(图6)。

古近纪渐新世沉积中心仍在渤海湾盆地，鄂尔多斯盆地外围也有部分渐新统沉积。鄂尔多斯盆地仅在西北部发育河流相沉积。河套盆地发育滨浅湖相、深湖—半深湖相，湖泊三角洲相。巴彦浩特盆地仅发育河流相。六盘山盆地、银川盆地、渭河盆地发育河流相和滨浅湖相。柳河盆地发育河流相。南华北地区除黄口凹陷发育滨浅湖相、深湖—半深湖相外，其他诸小盆地均发育河流相。渤海湾盆地发育滨浅湖相、河流相、河流平原亚相、深湖—

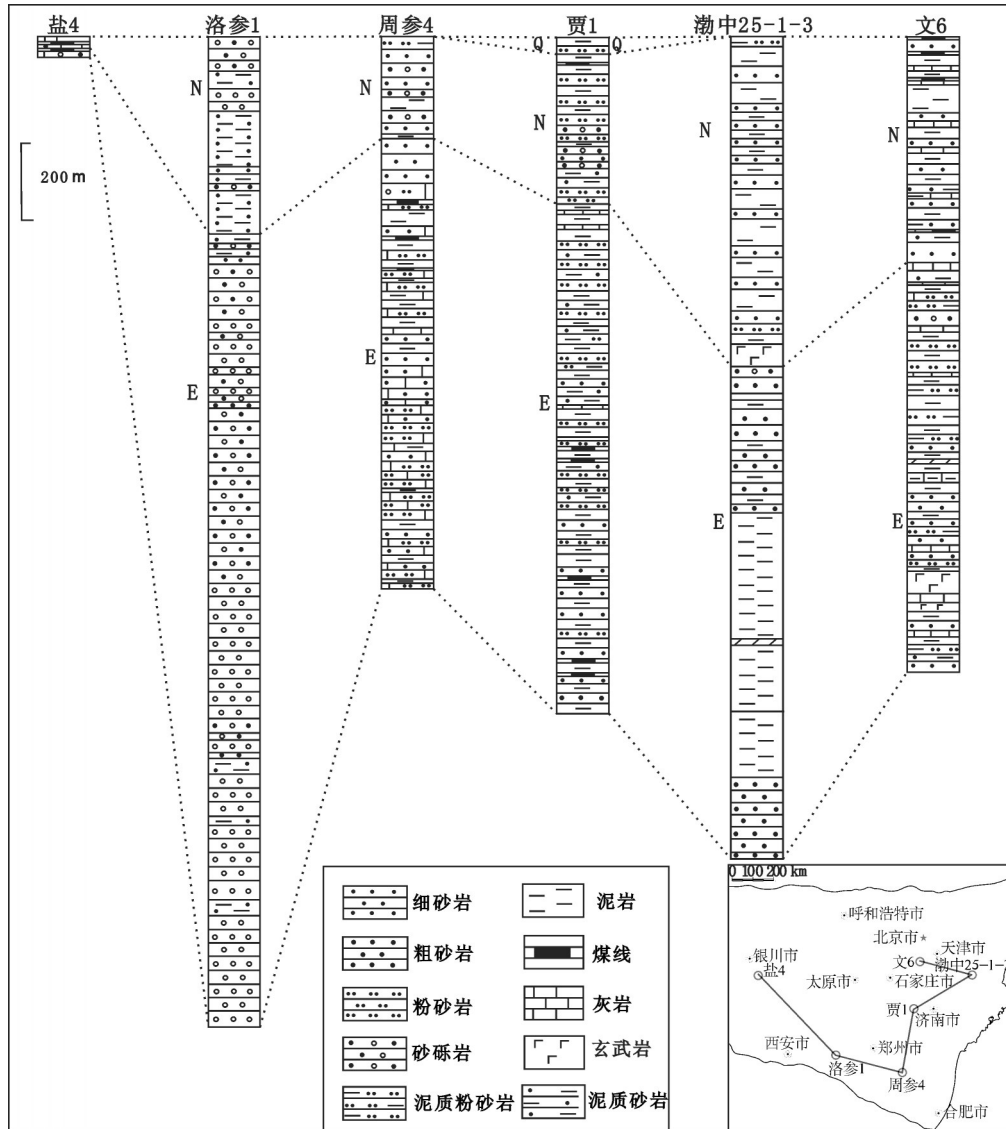


图2 华北地台区古近系—新近系地层对比柱状图

Fig.2 Correlation columnar section of Paleogene-Neogene strata in the area of North China Platform

半深湖相、三角洲相和冲洪积扇相(图7)。

新近系沉积区主要位于渤海湾盆地、南华北地区以及鄂尔多斯盆地外围的地堑中。河套盆地、银川盆地、六盘山盆地均为滨浅湖相沉积。渭河盆地为河流相、滨浅湖相沉积为主,局部发育深湖—半深湖相。南阳盆地、南华北盆地均为河流相沉积。临汾盆地、太原盆地、忻定盆地、蔚县盆地、大同盆地发育河流相、滨浅湖相。黄旗海盆地发育火山岩相。渤海湾盆地以河流相为主,局部发育滨浅湖相、河流平原亚相(图8)。

3 古地理特征

古近纪形成以断陷盆地为主的沉积以后,古近纪末期至新近纪早期,华北地台区盆地停止断陷并大面积隆起剥蚀,盆地最大挤压应力方向从北东—北东东向北西—北西西向转变,新近纪中晚期重新受印度板块向北北东方向俯冲作用控制,华北地台区整体沉降形成大型拗陷盆地^[21]。

3.1 渤海湾盆地

渤海湾盆地受控于太行山和郯庐为代表的西

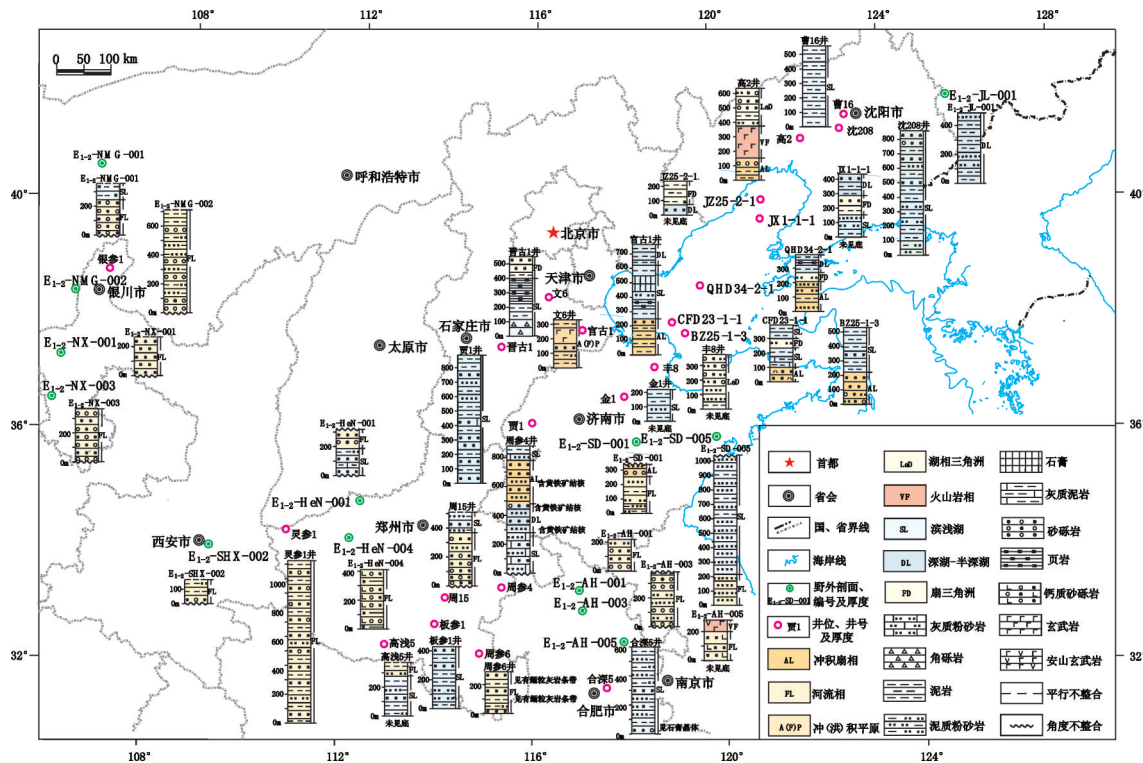


图3 华北地台区古近系古新统一始新统(E₁₋₂)实际材料图

Fig.3 Paleocene-Eocene (E₁₋₂) actual material map of Paleogene in the area of North China Platform

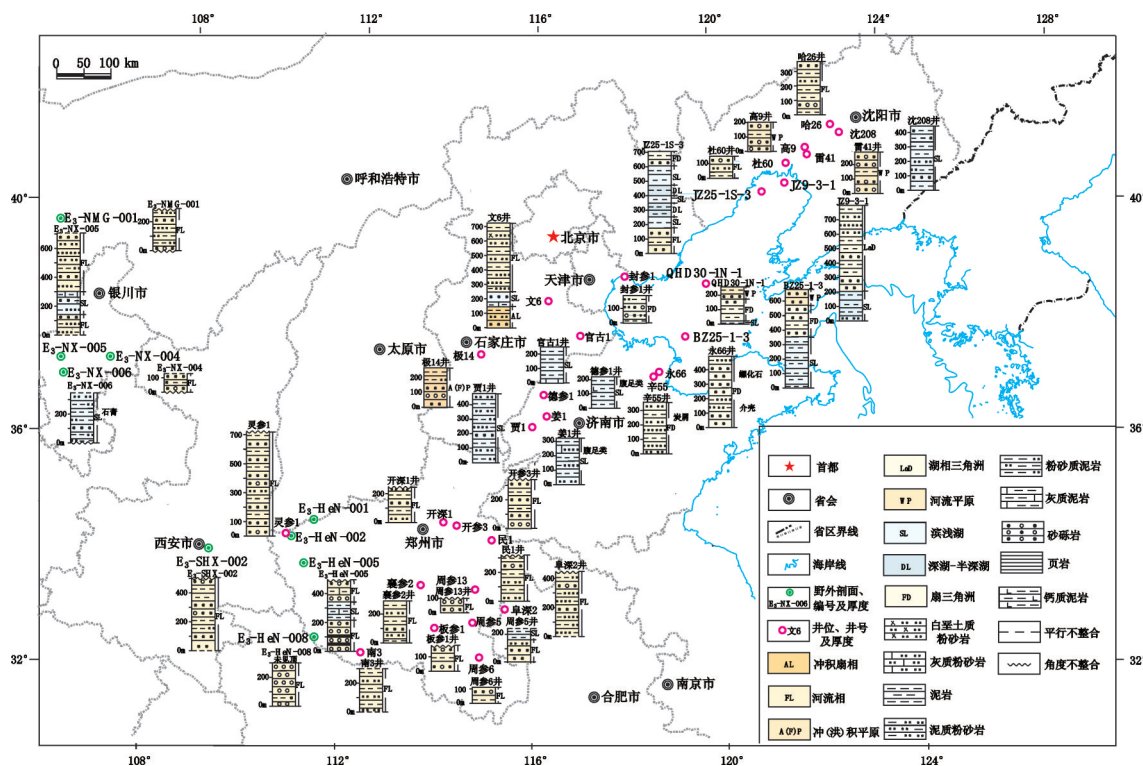


图4 华北地台区古近系渐新统(E₃)实际材料图

Fig.4 Oligocene (E₃) actual material map of Paleogene in the area of North China Platform

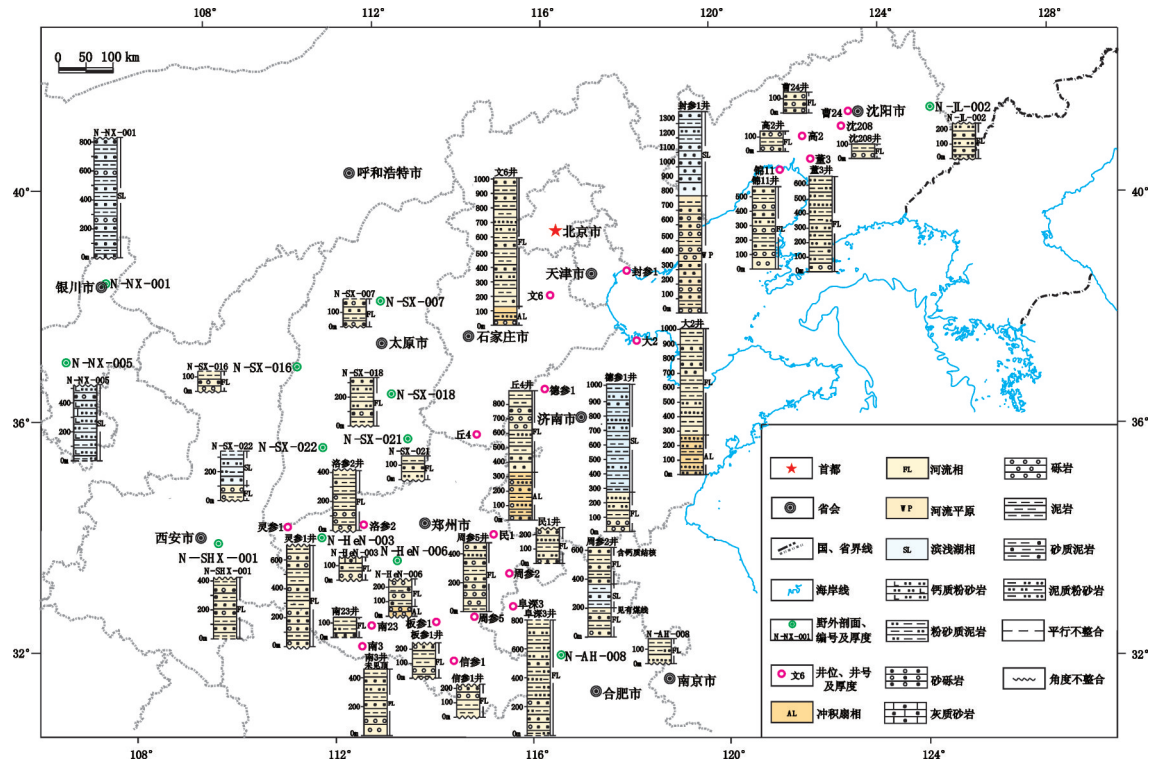


图5 华北地台区新近系(N)实际材料图

Fig. 5 Actual material map of Neogene (N) in the area of North China Platform

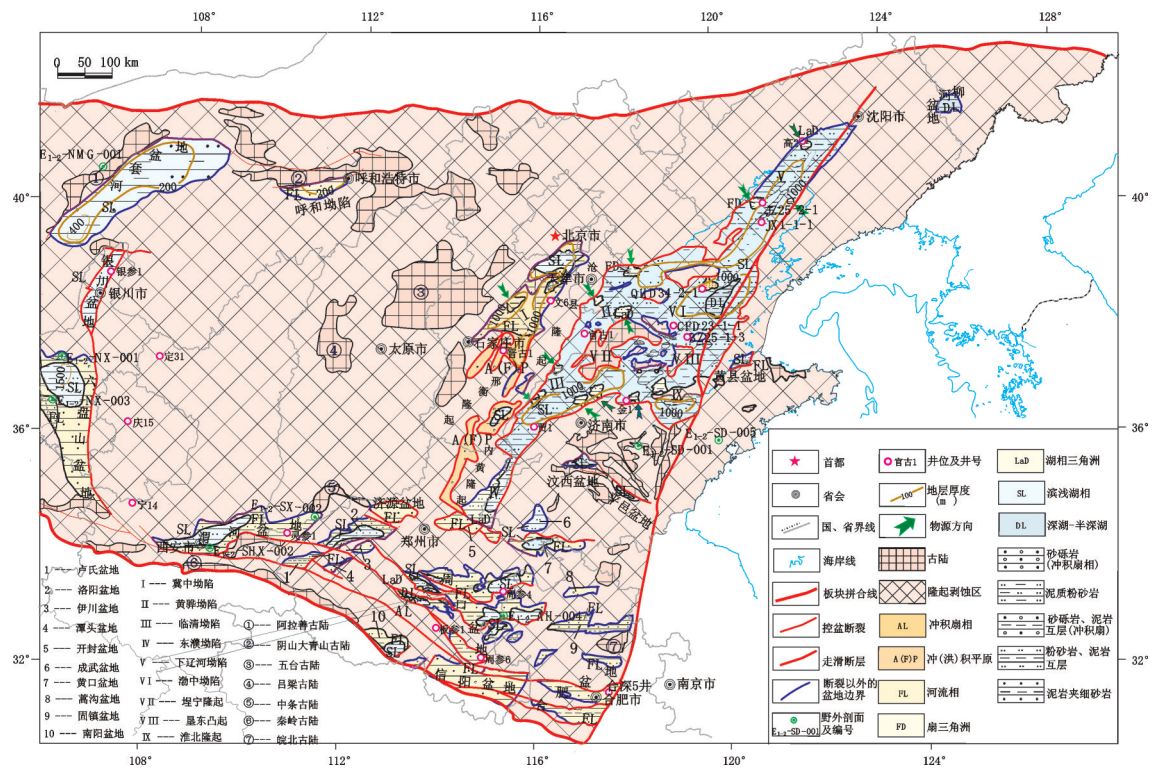


图6 华北地台区古近纪古新世—始新世(E₁₋₂)岩相古地理图

Fig.6 Paleocene–Eocene (E₁₋₂) lithofacies paleogeographic map of Paleogene in the area of North China Platform

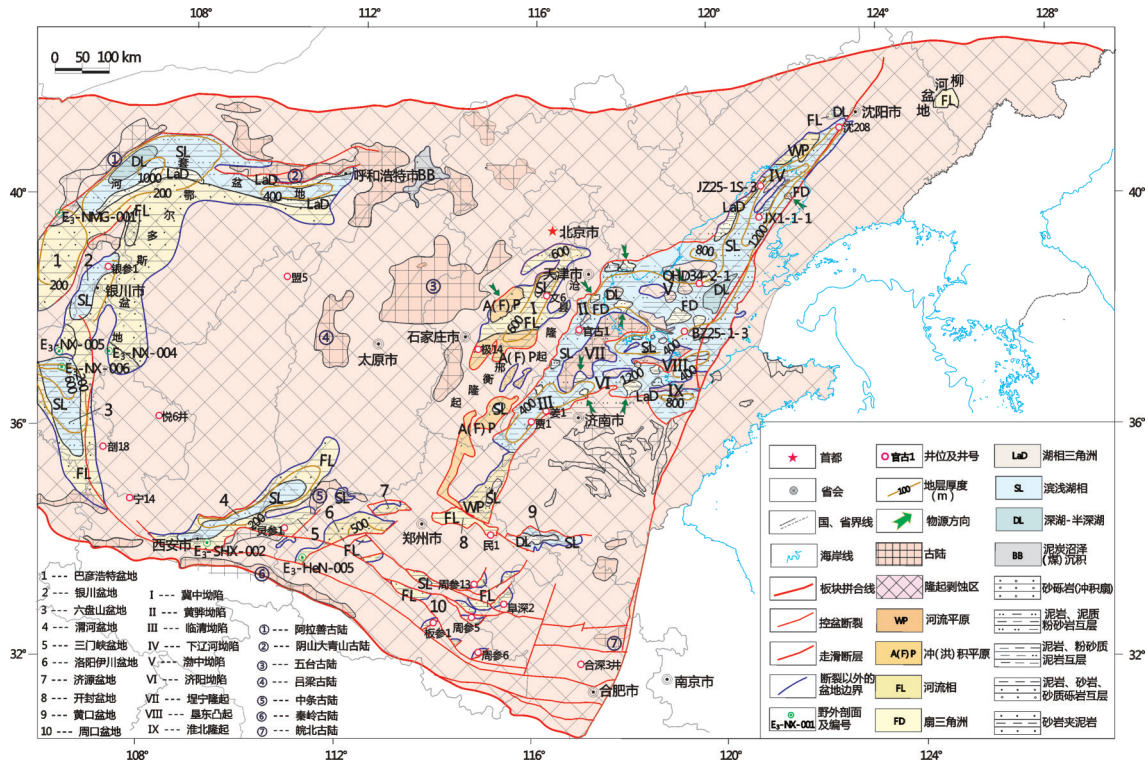


图7 华北地台区古近纪渐新世(E₃)岩相古地理图

Fig.7 Oligocene (E₃) lithofacies paleogeographic map of Paleogene in the area of North China Platform

太平洋“变换构造域”的控制,古近纪盆地沉积范围较中生界时期明显扩大,除盆地中部沧县隆起、埕宁隆起、东部的内黄隆起等之外,几乎都有沉积。各拗陷分别都有各自的沉积中心。但是在沉积相方面却表现明显的东西差异,东部以滨浅湖、半深湖沉积为主,而西部则主要以河流、冲积扇沉积占主导地位。这种东西差异的形成可能与西部的太行山快速隆升密切相关。该时期,盆地的物源来自多个方向,如北部的燕山褶皱带、西部的太行山隆起、南部的鲁西隆起、东部的辽东隆起区以及盆地内部的沧县隆起和埕宁隆起等(图6~7)。由于断陷带自西向东活动性强度增大,沉积中心自西向东逐渐转移,新近纪渤海湾盆地在前期断陷的基础上,盆地整体拗陷,在渤中拗陷、南堡凹陷发育滨浅湖沉积,其他地区主要以河流—泛滥平原沉积为主(图8)。

3.2 南华北地区

古近纪北西西南华北盆地主要受控于东西向的秦岭—大别—苏胶造山带的继承性的“古亚洲构造域”控制,被分割成大大小小的拗陷,接受沉积。济源—黄口地区古近纪地层就是分割性很强

的小型拗陷中沉积的。物源近、拗陷沉降速度快,沉积物多为红色粗碎屑岩,沉积环境多为洪积和河流,仅局部有湖相沉积^[22-23](图6~7)。南华北地区新近纪以来,经历了一次短暂的挤压抬升剥蚀后转入整体沉降,形成现今统一的南华北盆地,进入裂谷期后拗陷发育阶段,主要发育河流相^[24](图8)。在豫西断隆等地区发育的小型古近纪—新近纪盆地则发生整体抬升和遭受剥蚀,形成东西薄中间厚的态势,反映了东西高中间低的古地理环境。

3.3 鄂尔多斯盆地

古近纪继承了晚白垩世的挤压应力状态,仍处于整体隆起、剥蚀阶段。盆地内仅在西北部产生断陷盆地河流相与滨浅湖相沉积(图6~7)。新近纪鄂尔多斯地区继承了古近纪渐新世的古地理格局,仅在西北地区接受部分滨浅湖相与河流相沉积^[25](图8)。

4 古地理对油气分布的控制

古近纪有效烃源岩在渤海湾裂谷型盆地最为发育,在南华北断裂型盆地中相对不发育。渤海湾盆地沉积中心自南向北、自西向东不断向渤中拗陷

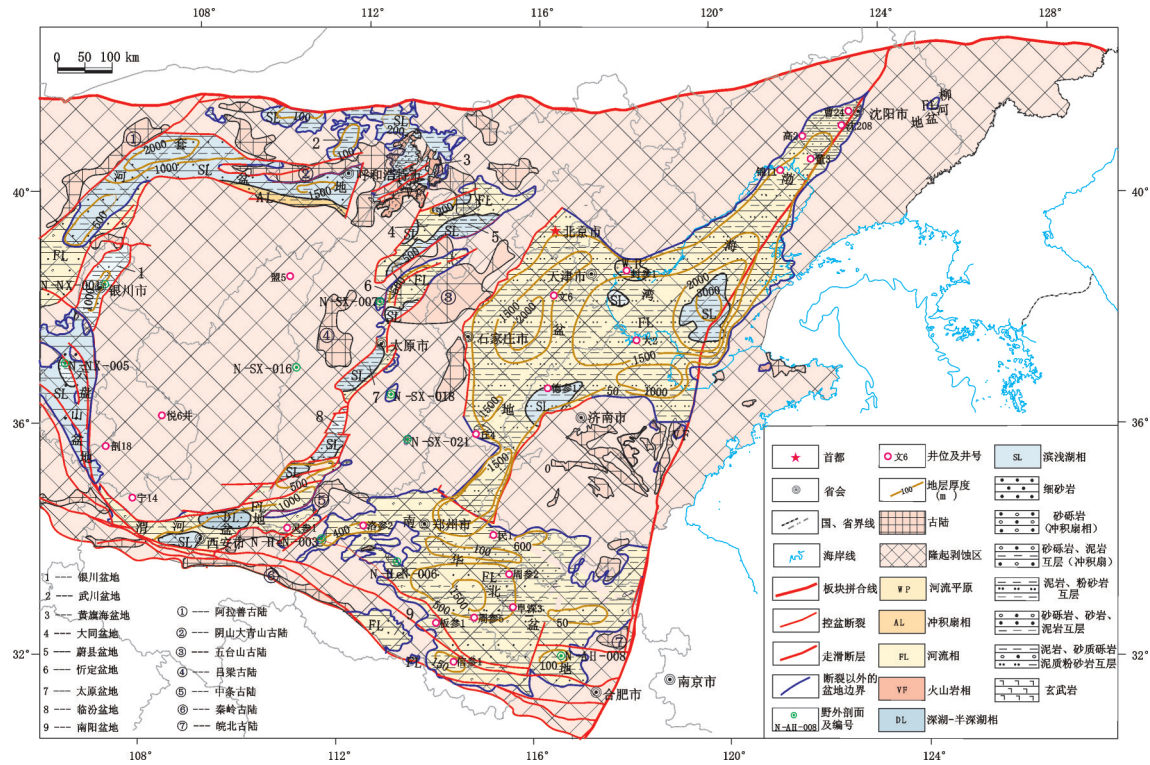


图8 华北地台区新近纪(N)岩相古地理图

Fig. 8 Lithofacies paleogeographic map of Neogene (N) in the area of North China Platform

转移,主要形成了孔店、沙三、沙四和东营组等4套烃源岩,其中以沙三段为主要烃源岩^[26]。孔店组烃源岩发育较为局限。沙河街组烃源岩是渤海湾盆地的主力烃源岩,也是油气资源富集层位。沙三段可分为沙三下亚段的油页岩为主的烃源岩和沙三中以暗色泥岩为主的烃源岩,其类型、丰度和演化程度均适宜形成丰富的油气资源,是渤海湾盆地多个坳陷的主力烃源岩。沙四段的烃源岩主要分布在沙四上亚段,系以一套咸水-半咸水条件下沉积的油页岩,有机质丰度高、类型好,成熟度中等到高,形成了大量工业储量。沙河街组沉积时期,沉积水体明显加深,深湖-半深湖沉积面积加大,气候大部分时期湿润,适于形成优质烃源岩^[27-28]。东营组烃源岩主要分布在渤中坳陷和黄骅坳陷,其有机质丰度中等,类型中等到较差,演化程度中等到较低,是渤中坳陷和黄骅坳陷重要的烃源岩。

华北地台区的渤海湾盆地古近系—新近系具有巨大的资源潜力,渤海湾盆地断陷活动性自西向东强度增大,烃源岩生油潜力也随之增大。其中渤

海湾盆地辽河、黄骅和冀中坳陷已证实有富油凹陷14个^[29]。位于渤中坳陷区的凹陷有22个,其中有20个被证实为生烃凹陷^[30]。济阳坳陷探明程度为53.8%,其中东营和沾化为济阳坳陷含油气资源的主力凹陷^[31]。

5 结论

(1)华北地台区古近系—新近系在渤海湾盆地沉积最厚,在南华北地区也有较厚沉积,而在鄂尔多斯盆地则不甚发育并缺失古新统一始新统。

(2)华北地台区古近纪古新世—始新世沉积中心移至渤海湾盆地,主要为滨浅湖相,其他地区发育河流相和滨浅湖相;渐新世沉积中心仍在渤海湾盆地,发育滨浅湖相、河流相和三角洲相,鄂尔多斯盆地发育河流相;新近系沉积区主要位于渤海湾盆地、南华北地区以及鄂尔多斯盆地外围的地堑中,主要为河流相和滨浅湖相。

(3)华北地台区古近纪—新近纪鄂尔多斯盆地仅在西北部接受沉积。南华北地区古近纪被分割

成大大小小的凹陷,接受沉积,新近纪进入裂谷期后拗陷发育阶段,大面积接受沉积,发育河流相。渤海湾盆地古近纪以断陷型沉积为主,物源来自多个方向,如北部的燕山褶皱带、西部的太行山隆起、南部的鲁西隆起、东部的辽东隆起区以及盆地内部的沧县隆起和埕宁隆起等。除盆地中部沧县隆起、埕宁隆起、东部的内黄隆起等之外,几乎都有沉积,新近纪渤海湾盆地大面积隆升,导致湖盆收缩,部分地区遭受剥蚀夷平,盆地整体由断陷转为拗陷。

致谢:审稿专家和编辑部李亚萍老师提出了宝贵修改意见,在此表示感谢!

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