安达曼海域马达班湾盆地石油地质特征及勘探方向

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摘要:马达班湾盆地位于安达曼海域,属于典型的弧后走滑拉张盆地,其构造演化与印度板块向缅甸微板块斜向俯冲密切相关。盆地沉积中心受实皆和墨干走滑断层控制,沉积物来源于北部的伊洛瓦底江和东北部的萨尔温江。从石油地质特征分析,研究区主要发育2套成熟烃源岩和1套生物气源岩。中中新统半深海相泥岩直接覆盖于下中新统—渐新统生物礁灰岩和浅海相砂岩之上,形成良好的储盖组合;上新统—更新统三角洲前缘砂、泥岩互层是浅层生物气的主要储盖组合。圈闭类型以断背斜、断块、生物礁圈闭及构造-岩性圈闭为主。断层和不整合面提供了有利的油气运移通道,具备较好的油气成藏条件。盆地沉积中心的断块和断垒是浅层生物气的主要勘探方向,而火山岛弧隆起带、盆地中央的继承性隆起以及东部斜坡带的构造次台阶是中深层热成因气的主要勘探方向。

关键词:弧后走滑拉张盆地 石油地质特征 勘探方向 马达班湾盆地 安达曼海域
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马达班湾盆地位于安达曼海域北部,西起安达曼-尼科巴岛链,东至特纳瑟利姆海岸,北接伊洛瓦底三角洲,南临安达曼深海盆地。其南北长约为290 km,东西宽约为220 km,面积约为6.4×10^4 km^2。盆地绝大部分区域水深小于500 m,安达曼深海盆地是马达班湾盆地向深水区的延伸。

截至2010年底,马达班湾盆地浅水区已发现亚得那、耶德贡和扎乌题卡大型气田以及多个中小型油气田[1-2],深水区勘探程度较低,部分区块已采集二维地震资料,但目前尚无井钻探。其中盆地东部斜坡带深水区,二维地震资料显示上新统存在较多的振幅异常,油气响应特征明显,表明研究区油气资源丰富,勘探潜力较大。笔者根据已有的地质、地震及钻井资料,对马达班湾盆地的石油地质特征及勘探潜力进行评价,指出未来的油气勘探方向。

1 区域地质概况

1.1 构造特征

马达班湾盆地可划分出5个构造单元,自西向东为火山岛弧隆起带、西部斜坡带、中央坳陷带、东部斜坡带和墨干台地(图1),均呈北北东—南南西向展布。火山岛弧隆起带是由多个火山岛弧组成的隆起带;中央坳陷带为盆地沉积中心,受实皆和墨干走滑断层控制,局部发育泥底辟和火山次隆;东部为墨干台地。在盆地中央坳陷带与其两侧隆起带之间的区域,分别称为西部斜坡带和东部斜坡带。安达曼深海盆地的构造格局与马达班湾盆地基本一致。

马达班湾盆地属于典型的弧后走滑拉张盆地,

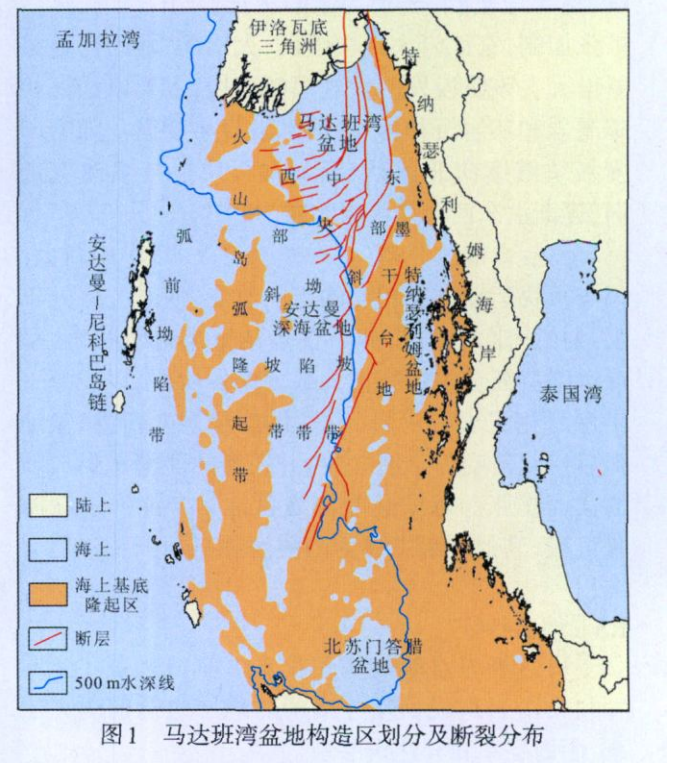

图1 马达班湾盆地构造区划分及断裂分布

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断裂十分发育，实皆和墨干走滑断层控制了盆地不同区域次级断层的走向。平面上，从西部到东部，断层走向由东西向、北东东向逐渐转变为南北向；纵向上，断层总体呈现倾角下缓上陡、断距下大上小的特点。其中深层（始新统—下中新统）以控坳大断裂为主，断层数量较少，构造走向为南北向；中浅层（中中新统—上新统）扭张性断裂十分发育，形成大量北东走向的断块和断垒等构造。

1.2　构造演化

马达班湾盆地的构造演化与印度板块向缅甸微板块斜向俯冲密切相关，经历了前裂谷期、裂谷期和弧后走滑拉分期3个演化阶段[2－6]。

前裂谷期（晚白垩世—始新世）　晚白垩世，马达班湾盆地为新特提斯洋的一部分，主要发育开阔海沉积；古新世，印度—澳大利亚板块中的大洋板块沿缅甸微板块发生B型俯冲，实皆断层开始形成；始新世，印度板块东北部俯冲到缅甸微板块之下，A型俯冲产生的地壳下拗导致沉积盆地开始形成，超过几千米的始新统沉积在下拗盆地内，在火山岛弧伴有大量火山活动，缅甸微板块发生顺时针旋转。

裂谷期（渐新世—早中新世）　渐新世，新特提斯洋几乎完全关闭。随着印度板块的持续斜向俯冲，实皆断层开始右旋走滑，盆地处于拉张初期阶段，呈半地堑状，表现为断陷特征；早中新世，弧后扩张加剧，玄武岩大规模喷发，火山岛弧隆升，地势差增大。该阶段发生大规模的海侵，主要以浅海相碎屑岩和灰岩沉积为主，局部发育生物礁。随着印度板块继续向北运动，缅甸微板块也持续改变走向，逐渐由东西向变为南北向。

弧后走滑拉分期（中中新世至今）　中中新世，因与板块运动方向相反的走向改变，使研究区处于强烈拉张走滑阶段，此后逐步结束半地堑状态，呈现坳陷特征。中中新世为最大海侵阶段，以浅海—半深海相泥岩和灰岩沉积为主；至早上新世，盆地弧后拉张转变为走滑拉分，并在安达曼海域形成新的洋壳扩张。除安达曼深海盆地为半深海—深海相沉积，其他地区主要为滨浅海和三角洲相碎屑岩沉积。

1.3　地层特征

马达班湾盆地的基底主要由前白垩系浅变质岩和火山岩组成。钻井揭示的地层包括前缅甸层系、缅甸层系和马达班层系[7－9]。

前缅甸层系　该层系包括上白垩统—始新统。前缅甸层系分为上前缅甸层系和下前缅甸层系，下前缅甸层系为上白垩统砂质层序，属非海相沉积环境，盆地东北部6CC－1井钻遇该套地层，主要由厚层砂岩和薄层泥岩组成，厚度超过1 300 m；上前缅甸层系为始新统砂、泥岩互层，为浅海沉积环境，厚层泥岩可能具生烃潜力，西部弧前区域1AA－2井钻遇该套地层，以砂岩为主，夹少量灰、泥岩互层，厚度为1 370 m。前缅甸层系沉积厚度大，但分布局限。

缅甸层系　该层系包括渐新统—中中新统。在盆地不同区域，其沉积特征具有较大差异。在盆地北部和东部主要由厚层砂岩、薄层泥岩组成，或砂岩、粉砂岩和泥岩互层，为滨岸相和浅海相沉积，钻井揭示厚度为1 300～2 210 m。在盆地南部由厚层泥岩夹少量砂岩、粉砂岩组成，为浅海相到深海相沉积，钻井揭示厚度为900～2 370 m。在盆地西部火山岛弧区，火山岩或火山碎屑岩基底上发育3期碳酸盐岩建造，即下缅甸层系灰岩、中缅甸层系灰岩和上缅甸层系灰岩，为浅海相沉积；3CA2，3DA1和3DA XA井钻遇上缅甸层系灰岩，为早中新世—中中新世。渐新世—中中新世发育浅海相厚层泥岩是马达班湾盆地最主要的烃源岩，中中新统半深海相泥岩直接覆盖于下中新统—渐新统生物礁灰岩和浅海相砂岩之上，形成良好的储盖组合。

马达班层系　该层系主要包括中中新统—全新统。在全盆地均有发育，其中盆地南部沉积厚度最大，以泥岩为主，夹多套厚层砂岩。3DA X井揭示其底部为浅海相砂岩不整合于生物礁灰岩之上。平面上，马达班层系在盆地东北部以滨岸相到浅海相沉积为主，而在盆地西南部以浅海相—深海相沉积为主；纵向上，该层系从典型的前三角洲相演变为三角洲前缘相。上新统—更新统的三角洲前缘砂、泥岩互层是盆地浅层生物气的主要储盖组合。

2　石油地质特征

2.1　烃源岩

根据区域研究和钻井资料分析，马达班湾盆地共发育4套烃源岩，分别为始新统浅海相泥岩、渐新统—下中新统浅海相泥岩、中中新统浅海—半深海相泥岩和上新统前三角洲相泥岩。渐新统—下中新统烃源岩和中中新统烃源岩是中深层热成因气的主要来源，上新统烃源岩是浅层生物气的主要来源，而始新统烃源岩分布局限，生烃潜力有限。

渐新统—下中新统烃源岩　渐新世—早中新世，马达班湾盆地处于拉张初期阶段，呈半地堑状，由于大规模海侵作用，沉积了1套半封闭浅海相泥

岩。该套烃源岩主要分布于马达班湾盆地中央坳陷区,受实皆和墨干走滑断层控制,有机质丰度高,干酪根类型以Ⅱ型和Ⅲ型为主;钻井揭示其烃源岩残余有机碳含量(*TOC*)为0.6%～3%,最高可达6%;烃源岩热解氢指数(I_H)为100～400 mg/g;镜质组反射率为0.6%～1.3%,在盆地埋深更大的区域,成熟度则更高。该套烃源岩以产气为主,生烃高峰期为上新世—更新世,但M8-A1井揭示盆地西部弧前坳陷由于埋深不足,该套烃源岩尚未成熟。

中中新统烃源岩　中中新世,盆地处于强烈拉张走滑阶段,逐步结束了半地堑状态,表现为坳陷特征。中中新世为最大海侵阶段,沉积了1套浅海相—半深海相泥岩,几乎全盆地均有分布。钻井揭示中中新统烃源岩的*TOC*为0.4%～1.8%,I_H为160～320 mg/g,为中等—好烃源岩,且在盆地沉积中心部位已进入成熟阶段,以产气为主。

上新统烃源岩　上新世—更新世,北部伊洛瓦底江和东北部萨尔温江提供了大量物源。因沉积中心有合适的沉积速率和地温梯度,上新统烃源岩可以作为生物气的主要烃源岩。该套烃源岩为前三角洲相泥岩,钻井揭示其*TOC*值为0.2%～1.6%,烃源岩生烃潜量为0.05～4.53 mg/g,埋深一般小于1 800 m,地层温度低于75 ℃,以细菌活动为主,相当于泥炭—褐煤演化阶段,生物气表现为干气特征[2]。

2.2　储盖组合

马达班湾盆地主要发育4套储层,分别为渐新统—下中新统碳酸盐岩、渐新统—下中新统浅海相砂岩、上新统—更新统三角洲前缘砂岩和基底风化壳储层。渐新世—早中新世,东北部萨尔温江为马达班湾盆地提供了主要的沉积物源,而北部伊洛瓦底江汇水区主要集中在缅甸的中央盆地区。因此,渐新统—下中新统碳酸盐岩储层主要分布在火山岛弧隆起带和盆地中央的继承性隆起上,而渐新统—下中新统浅海相砂岩主要分布于东部斜坡带。中中新统半深海相泥岩直接覆盖在上述2类储层之上,形成良好的储盖组合。上新世—更新世,伊洛瓦底江和萨尔温江输送了大量的沉积物进入马达班湾盆地,广泛发育的三角洲前缘砂、泥岩互层是浅层生物气的主要储盖组合。基底风化壳储层之上直接覆盖中中新统半深海相泥岩也是研究区潜在的储盖组合。

2.3　圈闭条件

马达班湾盆地发育多种类型圈闭,构造演化、断层活动强度及沉积环境差异控制了盆地不同区域的圈闭发育特征[2]。其中,火山岛弧隆起带以背斜或断背斜圈闭为主,同时,由于渐新世—早中新世在火山岛弧上发育大量碳酸盐岩建造,因此存在与碳酸盐岩相关的生物礁型圈闭;西部斜坡带主要发育砂体尖灭岩性圈闭;中央坳陷带受实皆和墨干走滑断层及伴生断层的影响,在中浅层主要形成断块和断垒圈闭,在盆地中央局部发育火山次隆,形成生物礁圈闭和继承性隆起背斜圈闭;东部斜坡带主要发育断背斜、岩性圈闭以及构造-岩性圈闭。此外,在盆地北部和东北部,发育大量泥底辟及相关构造圈闭。

2.4　油气运移及保存条件

渐新世—早中新世,马达班湾盆地发育多个区域性不整合面。亚得那气田和耶德贡凝析气田揭示(图2),西部火山岛弧隆起带和东部斜坡带油气主要来源于中央坳陷带深部的成熟烃源岩,油气通过中深层控坳大断裂和多个区域性不整合面侧向运移至圈闭。在盆地中央坳陷带,扭张性断裂是浅层生物气的主要运移通道,油气以垂向运移为主。

针对研究区中深层圈闭而言,由于中中新世为最大海侵阶段,广泛发育1套半深海相泥岩,直接覆

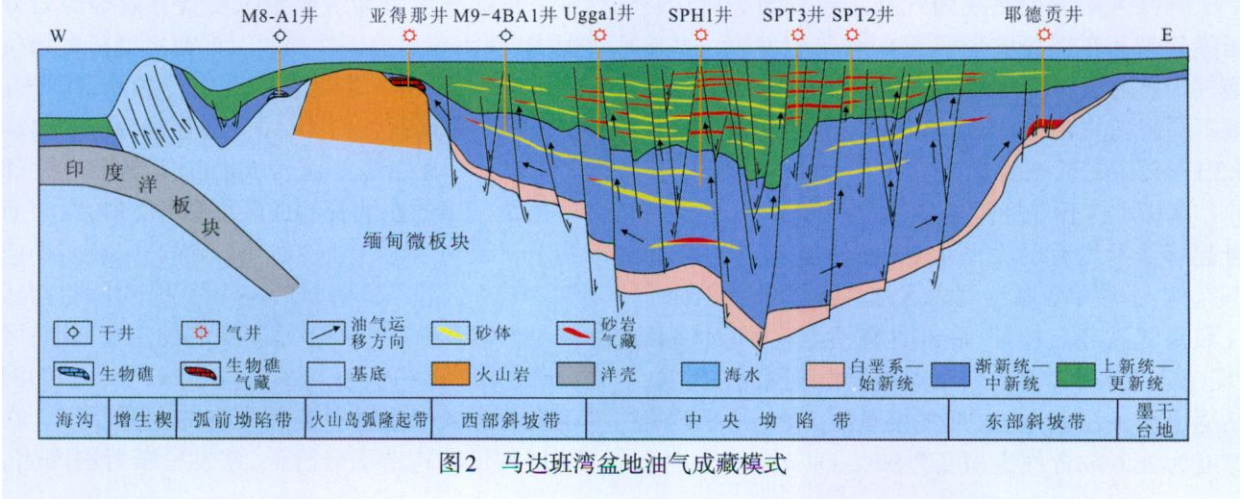

图2　马达班湾盆地油气成藏模式

盖在中深层圈闭上，尽管受后期走滑活动影响，油气保存条件仍较好。而浅层圈闭基本以断块和断垒为主，扭张性断裂大部分通至海底，因此断层侧向封堵条件对浅层气藏的保存起重要作用。

3　油气分布规律及主控因素

3.1　浅层生物气藏

研究区浅层生物气藏的水深一般小于200 m，埋深不超过2 000 m。目前已发现多个生物气藏，主要分布于盆地沉积中心的上新统和更新统，其甲烷稳定碳同位素（$\delta^{13}C$）小于–60‰，部分生物气藏混有热成因气，$\delta^{13}C$为–60‰～–50‰。地震剖面表现为明显的亮点、平点、极性反转、空白反射和频率降低等油气响应特征，且地震反射异常紧邻断层两侧分布，易于识别。多套气层垂向叠合，在盆地沉积中心叠合数量多，向盆地边缘叠合数量减少。单个气藏规模普遍较小，圈闭资源量一般小于200×10^8 m^3，多为30×10^8～80×10^8 m^3，需开展联合勘探开发。

生物气源岩、沉积相带和侧向封堵条件控制了生物气藏的分布和规模。盆地沉积中心具有相对有利的生物气生成条件，比如更高的沉积速率、更丰富的未成熟有机质等，同时生物气主要依靠中浅层扭张性断裂垂向运移至上覆圈闭，导致盆地沉积中心生物气藏数量和规模明显超过盆地边缘。中浅层圈闭基本以断块或断垒为主，油气聚集主要受断层性质、断距、泥岩盖层视厚度和储层砂岩视厚度等因素影响[10–11]。统计研究区30余口钻井资料发现，圈闭所处的沉积亚相及断距规模是其能否成藏的关键，钻探失利的圈闭多因储层太厚、断距太小，使侧向“砂—砂”对接，从而造成天然气漏失，断距和砂泥比严格控制了气柱高度和气藏规模[2]。

3.2　中深层热成因气藏

研究区中深层热成因气藏主要分布于火山岛弧隆起带和东部斜坡带，西部斜坡带也发现一些小型气田。通过对已知油气藏和失利井分析揭示，盆地不同区域的油气成藏主控因素有较大差异。

3.2.1　火山岛弧隆起带

亚得那气田位于西部火山岛弧隆起带，是火山隆起背景上发育的大型生物礁气藏。其生物礁形态完整，上覆1套厚层泥岩区域盖层。地震剖面上气藏顶部具亮点特征，底部存在平点，为气水界面（图3）。亚得那2井位于亚得那生物礁圈闭东北翼，钻遇上缅甸层系灰岩，纯气层厚度为81 m，平均孔隙度为26.6%，含气饱和度为80%，油气来源于中央坳陷带渐新统—中新统烃源岩，以侧向运移为主。

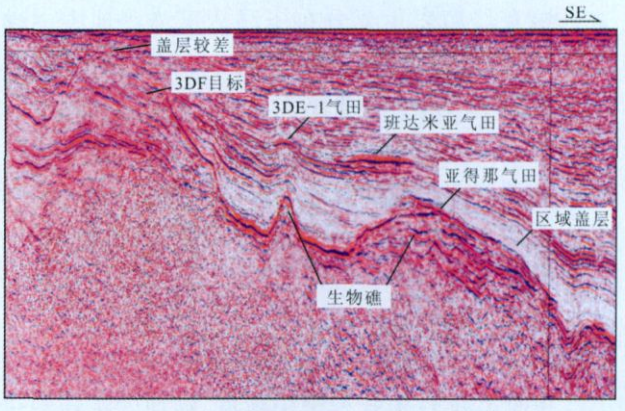

图3　过亚得那气田北西—南东向地震剖面

火山岛弧隆起带油气成藏主要受古地貌、封盖条件及有效烃源岩分布范围控制。渐新世—早中新世，该区域构造高部位常发育生物礁，因此，古地貌决定了生物礁的分布范围。部分基底较高，遭受剥蚀削截，中新统半深海相泥岩直接覆盖于火山岩基底之上或未接受该套泥岩沉积，导致储层和封盖条件变差。邻近亚得那气田西北部构造高部位的3DF目标，已钻井1口，为干井，分析失利原因为缺少有效盖层。西部火山岛弧隆起带油气主要来源于中央坳陷带渐新统—中新统烃源岩，而在弧前坳陷带该套烃源岩尚未成熟。2000年，在弧前坳陷带M8区块钻井1口，目标为火山岛弧隆起带西侧弧前坳陷带次隆上发育的生物礁，结果无明显油气显示。该井钻遇下中新统生物礁灰岩储层的厚度为284 m，储层物性好，平均孔隙度为19%，净总比为90%，测井解释为水层；地震剖面显示碳酸盐岩顶部存在1套弱振幅反射，为中中新统区域泥岩盖层。分析失利原因是弧前坳陷带缺乏成熟烃源岩，而火山岛弧隆起带阻止了中央坳陷带的热成因气进一步西移。

3.2.2　东部斜坡带

东部斜坡带油气成藏主要受有效烃源岩分布范围、圈闭和封盖条件控制。耶德贡凝析气田位于东部斜坡带，为构造次台阶上发育的断背斜气藏。储层为下中新统浅海相砂岩，油气来源于中央坳陷带渐新统—中新统烃源岩，以侧向运移为主。邻近耶德贡气田的东北部，M1区块钻井2口，在中新统和上新统均钻遇大套砂岩和粉砂岩，未获得商业油气。其中区块东部的M1 A－1井为干井，目前认为缺少气源和盖层条件差是其失利的主要原因；区块西部的M1 B－1井获得少量气显示，分析认为圈闭不发育和盖层条件差是其失利的主要原因。在东部斜坡带的构造次台阶上，常发育断背斜圈闭，是

该区最主要的勘探目标。

3.2.3　西部斜坡带和中央坳陷带

西部斜坡带和中央坳陷带油气成藏主要受圈闭和储层控制。扎提纳气田位于西部斜坡带，为火山次隆背景下发育的低幅度背斜气藏。储层为中新统浅海相砂岩，油气来源于中央坳陷带渐新统—中新统烃源岩，以垂向运移为主。同时，该火山基底之上钻遇致密灰岩，无油气显示。由于该区域火山次隆地势低于西部火山岛弧隆起带，受沉积环境和未遭受暴露溶蚀作用的影响，碳酸盐岩一般比较致密，储层物性较差，地势较高处储层物性可能变好。此外，西部斜坡带还存在断层遮挡的砂体上倾尖灭圈闭，中央坳陷带继承性隆起上常发育低幅度背斜圈闭，均是潜在的勘探目标。

3.2.4　墨干台地

墨干台地油气成藏主要受有效烃源岩分布范围控制。M15，M16，M17和M18区块已钻井5口，均为干井，推测失利原因为缺少有效烃源岩。通过区域地震剖面可见，M15，M16，M17和M18区块地层沉积厚度较薄，缺乏生烃潜力，而墨干台地西部边缘隆起带阻止了中央坳陷带热成因气进一步东移。

4　油气勘探方向

马达班湾盆地具有优越的油气地质条件，是缅甸海上重要的产油气盆地之一。2000年美国地质调查局（USGS）预测马达班湾盆地（包括安达曼深海盆地）待发现原油、凝析油和天然气可采资源量分别为0.17×10^8 t，0.72×10^8 t和$4\ 103\times10^8$ m^3，勘探潜力较大。综合其石油地质特征、油气分布规律及成藏主控因素分析，提出以下油气勘探方向。

从勘探区带来看，盆地沉积中心的断块和断垒是浅层生物气藏的主要勘探方向，而火山岛弧隆起带、盆地中央的继承性隆起以及东部斜坡带的构造次台阶是中深层热成因气藏的主要勘探方向。

从勘探层系来看，研究区主要有浅层和中深层2套勘探层系。其中，浅层主要包括上新统—更新统，以生物气为主，单个气藏规模较小，单独开发没有经济效益，需开展联合勘探开发；中深层主要包括渐新统—中新统，以热成因气为主，单个气藏规模较大，在西部火山岛弧隆起带和东部斜坡带均有大型气田发现，是研究区寻找大型气田的主要勘探层系。

此外，需要重视对安达曼海域深水区的勘探。通过二维地震资料分析，东部斜坡带深水区上新统振幅异常体表现为明显的亮点或平点特征，沿墨干断层西侧呈条带状分布，与构造叠合较好。同时，中深层还存在下中新统构造圈闭和基底构造圈闭，具有较大的勘探潜力。

5　结论

马达班湾盆地属于典型的弧后走滑拉张盆地，其构造演化与印度板块向缅甸微板块斜向俯冲密切相关。研究区主要有浅层和中深层2套勘探层系，油气主要来源于中央坳陷带渐新统—中中新统烃源岩。其中浅层以生物气藏为主，主要分布于盆地沉积中心，油气成藏受生物气源岩、沉积相带和断层侧向封堵条件控制；中深层以热成因气藏为主，主要分布于火山岛弧隆起带、盆地中央的继承性隆起以及东部斜坡带的构造次台阶。在盆地的不同区域，其油气成藏的主控因素具有较大差异。安达曼海域深水区具有较大的勘探潜力，尤其是目前勘探程度较低的东部斜坡带深水区。

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Xu Zhicheng, Lü Fuliang, Fan Guozhang et al. Deepwater petroleum geology and exploration potential of West Africa coastal basins. *PGRE*, 2012,19(5):1-5.

Abstract: On the basis of plate tectonic theory and petroleum geology theory, we analyzed the formation and evolution of West Africa coastal basins, studied deepwater exploration data and typical deepwater oil & gas fields, and discussed petroleum geologic characteristics and exploration potential of deepwater areas in West Africa. The evolution of West Africa coastal basins can be divided into pre-rift stage, syn-rift stage, and post-rift stage. Controlled by formation and evolution of the basins, most of deepwater fields developed in post-rift stage and oil fields are predominant. Oil and gas found in West Africa deepwater settings are generated from Lower Cretaceous (syn-rift stage) lacustrine source rocks, Upper Cretaceous and Tertiary (post-rift stage) marine source rocks. The most important deepwater reservoirs are turbidite channel sandstone. The main types of deepwater traps are combined stratigraphic-structural traps, followed by structural traps and stratigraphic traps. Deepwater exploration potential is best in Lower Congo basin and Niger Delta, and is good in Cote D'ivoire basin, Benin basin and Senegal basin. Douala basin and Rio Muni basin have fair deepwater exploration potential, whereas, deepwater exploration may be highly risky in Kwanza basin.

Key words: deepwater area; petroleum geology; exploration potential; turbidities; West Africa coastal basins

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Teng Jianbin. Classification and guiding significance based on primary micro-factors of low-permeability reservoir-case study on lower Sha3 reservoir in Lin'nan depression. *PGRE*, 2012,19(5):6-9.

Abstract: Clastic reservoirs are highly developed in lower Sha3 reservoir of Lin'nan depression, with low-permeability and extra-low permeability reservoir that is high in amount and difficult to explore. Based on studies about the key elements of sandstone acidization, the oil reservoir is divided into four categories corresponding to ten types by analyzing petrology microeconomic and causes factors of reservoir in study area. Production stimulation treatments are proposed according to the study on primary microeconomic factors. Category A reservoir has good natural capacity by treating the acidized damage zone, and this Category is named low natural production low permeability reservoir. Using acid can dissolute carbonate cementation in Category B reservoir, it increases the porosity and permeability, and then obtains good capacity, therefore, the Category B is named acidization controlled low and extra-low permeability oil reservoir. According to interstitial content type, the Category C reservoir is classified into mid-crystal carbonate cement type, argillaceous cement type, plastic components filling type and secondary quartz cement type. Different types should be treated by different acidization fracturing measures. It is named acidization and fracturing controlled low and extra-low permeability oil reservoir. Capacity of Category D is very low by fracturing and (or) acidization, and it is named difficult to use of extra-low permeability reservoir. This series of new classification not only can apply to evaluation of the quality and potential of the low-permeability reservoir, but also can improve the producing rate and recovery of the low-permeability reservoir.

Key words: diagenesis; occurrence status; low permeability genesis; sensitivity mineral; acidization; Lin'nan depression

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Han Zongyuan. Organic geochemical characteristics of source rocks in well-Zhentan1, Ordos Basin. *PGRE*, 2012,19(5): 10-14.

Abstract: Using analytic methods of thermal decomposition experiment, microscopic observation, organic elemental analysis and vitrinite reflectance, and based on study on abundance, types, maturity, and biomarkers of organic matter, this paper comparatively analyzes the organic geochemical characters of Mesozoic and Palaeozoic source rocks of well-Zhentan1 in Ordos Basin. The source rocks of T*y* and J*y* are comprehensively evaluated as medium source rocks, owning high generating capability of liquid hydrocarbon and having high organic content, the kerogen are mainly humic kerogen, and the organic matters are now in the mature stage. The source rocks of P*sh* and P*t* are comprehensively evaluated as poor source rocks, owning high generating capability of gaseous hydrocarbon and having low organic content, the kerogen are mainly humic kerogen, and the organic matters are now in the over mature stage. Mesozoic organic matters whose original biologic assemble are dominated by terrestrial plants and deposited in weak-reducing and oxygen free environment of lacustrine facies. The Palaeozoic organic matters whose original biologic assemble are both terrestrial plants and aquatic community are accumulated and preserved in the reducing environment of lacustrine facies.

Key words: source rock; geochemical characteristics; kerogen; biomarker; reducing environment

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Wang Hongping, Lü Fuliang, Fan Guozhang et al. Petroleum geology and exploration direction of Martaban Basin in Andaman Sea. *PGRE*, 2012,19(5):15-19.

Abstract:Martaban Basin located in Andaman Sea, is a typical back-arc strike slip and extension basin. The tectonic evolution of Martaban Basin is closely related with the oblique convergence of the Indian beneath the Myanmar plates. Its depocenter is controlled by the Mergui and Sagaing strike-slip faults and the main sources are from the Irrawaddy River in the north and Salween River in the northeast respectively. From the analysis of characteristics of petroleum geology, the Martaban Basin comprises two mature hydrocarbon source rocks and one biological gas source rock. The Middle Miocene hemipelagic shales overlie the Oligocene-Lower Miocene reef limestones and shallow marine sandstones, which comprise good reservoir-seal assemblages. The Pliocene-Pleistocene delta front sandstones interbedded with shales are the main pays of shallow biogas. The trap types are mainly faulted-anticlines, faulted blocks, reef traps and structural-stratigraphic combined traps. Faults and unconformities are the favorable migration pathways. Future exploration should typically be oriented at faulted blocks and horst in the center area of basin for the shallow biogas, and the western volcanic uplifts, central inherited uplifts and structural terraces in eastern ramp region for the thermogenic gas respectively.

Key words:back-arc strike slip and extension basin; petroleum geology feature; exploration direction; Martaban Basin; Andaman Sea

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Liu Xinjin, Song Guoqi, Liu Huimin et al. Study of conglomerate reservoir types and distribution in north slope zone, Dongying depression. *PGRE*, 2012, 19(5): 20-23.

Abstract:There are several conglomerate reservoir types in the eastern north steep slope zone in Dongying depression, whose distribution has an ordered sequence. By the dissection of different conglomerate traps, the basic characteristics of these reservoirs and controlling factors of their ordered distribution are discussed. On the basis of reservoir characteristic and distribution law, the ordered reservoir combination pattern includes under-salt condensate gas reservoir, fan root lithologic reservoir, structural-lithological reservoir, and the digenesis trap reservoir that is sealed by difference of physical properties. The reservoir series, that are in order of under-salt gas play, deep zone thin oil play, medium-deep thin oil play, and shallow layer heavy oil play, are distributed ring-shaped around the subsidence centre of the basin. Every reservoir type had its particular hydrocarbon accumulation controlling factors. The main pool controlling factors of deep condensate gas and thin oil lithologic reservoir are the sealing capacity of fan root, the one for medium-deep structural-lithologic reservoir is development of small anticlinal traps, and the heavy oil is thick, which is the key controlling factors for shallow layer reservoir that is sealed by difference of physical properties. Different exploration plans are designed according to the reservoir characters and oil distribution law.

Key words:conglomerate; reservoir types; evolutionary series; controlling factor; Dongying sag

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Liu Qidong. Sand-body distribution of the E_1f_3 member and its relationship with hydrocarbon migration in the northern slope of Gaoyou sag. *PGRE*, 2012, 19(5): 24-26.

Abstract:The E_1f_3 member is featured by serious reservoir heterogeneity and complex hydrocarbon migration pathways. Based on the study of sedimentary microfacies and stratigraphic correlation of the sand sets, we analyze comprehensively the hydrocarbon migration pathway by integrating oil and gas show of drilling data in this paper. The result indicates that there are 3-5 subaqueous distributary channels in every sand subset in the north slope of Gaoyou sag, and the study shows that the subaqueous distributary channel and channel-mouth bar are more available for the reservoir property, and its sand-body distribution controls the spread of the high quality reservoir. Further analysis reveals that the hydrocarbon migration pathways are different between the inner and the outer slope. In the inner slope, the hydrocarbon migration pathways are influenced by the distribution of subaqueous distributary channel, and in the outer slope, the hydrocarbon migration pathways are controlled by both the tectonic zone and the sand-body distribution. So, different prospecting tactics in the inner and the outer slope should be considered.

Key words:E_1f_3 member; sand-body distribution; oil and gas show; hydrocarbon migration; north slope of Gaoyou sag

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Zhang Xintao, Niu Chengmin, Huang Jiangbo et al. Hydrocarbon migration of Bozhong34 in Lower Minghuazhen Formation, Huanghekou sag, offshore Bohai sea. *PGRE*, 2012, 19(5): 27-30.

Abstract:The characteristics of migration system and its relationship with the distribution of middle shallow hydrocarbon reservoir in the Bozhong34 block of the Huanghekou sag in the offshore Bohai Bay Basin show that, the faults and sandbodies dominate the hydrocarbon migration system in the block. The distribution of sandbodies and faults are not the only factor that controls hydrocarbon enrichment in the study area. The spatial and temporal configurations of faults and sandbodies also control the effectiveness of migration system, thus determine the formation and occurrence of the oil reservoirs in the middle shallow layers. Through the static model of faults and sandbodies, the contact area of faults and sandbodies is important parameter controlling oil-gas filling degree, reserves abundance, and oil column height. Moreover, it guides the well position of Bozhong34-B and reservoir prediction. Quantitative study about configurations of faults and sandbodies with petroleum accumulation model has important value in theory and field application for expanding exploration space and locating the potential reservoir.

Key words:faults; migration system; configurations of faults and sandbodies; hydrocarbon migration; Huanghekou sag

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