二连盆地断陷湖盆沉积砂体分布主要控制因素

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摘要：二连盆地以发育中、新生代小型断陷湖盆群为特征，具有形成地层岩性油藏的良好地质条件。针对盆地内断陷湖盆规模小、物源多、沉积快速及相带变化快的特点，以沉积砂体形成、分布过程为主线，通过古地貌及地震沉积相分析、典型沉积砂体剖析等，针对物源供给、运载路径和砂体沉积等进行分析，开展沉积砂体分布主要控制因素研究。结果表明，古物源、古沟谷和坡折带是二连盆地断陷湖盆沉积砂体分布的主要控制因素；凹陷周缘与内部古高地控制沉积物的入湖位置和物源供给，控凹断层等控制形成的古沟谷是沉积砂体的主要搬运路径，不同类型的构造（沉积）坡折带控制沉积砂体的叠合方式及分布特征。断陷湖盆内古物源、古沟谷和坡折带的有机配置，共同控制了研究区沉积砂体的形成与分布。

关键词：地层岩性油藏 沉积砂体分布 控制因素 断陷湖盆 二连盆地
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二连盆地是由多个具有相似发育历史的裂谷型小断陷组成的湖盆群，盆地内断陷湖盆沉积体系具有多物源、近物源、相变快、相带窄和粗碎屑的特点[1]，具备形成地层岩性油藏的良好地质条件。勘探实践表明，沉积砂体形成与分布研究是开展地层岩性油藏勘探的基础和关键。众多学者对断陷湖盆内沉积砂体的分布与控制因素作了大量研究[2-10]，认为断陷湖盆古地貌、坡折带等因素对沉积砂体发育与分布具有明显的控制作用。前人对二连盆地沉积相与沉积砂体分布也进行了较为深入的分析，认为研究区主要发育高能环境下快速沉积的中—小型扇三角洲、辫状河三角洲、近岸水下扇和湖底扇等沉积砂体[11]，坡折带具有控层、控相和控砂的作用[1]。

随着二连盆地地层岩性油藏勘探程度的不断深入，研究与勘探对象由分布范围较大的厚沉积砂体逐步转向分布范围较小、纵向叠置的薄沉积砂体。因此，开展沉积砂体的精细研究，明确其主要控制因素，进而准确预测沉积砂体的空间分布，成为亟待解决的关键问题。针对研究区断陷湖盆规模小、沉积砂体类型多、分布相带窄、纵横向变化快等特点，在三维地震资料精细构造解释的基础上，对古构造、高分辨率层序地层、地震沉积相和典型沉积砂体等进行了研究，分析了沉积砂体分布的主要控制因素，以期为实现研究区地层岩性油藏勘探的新发现起到借鉴和促进作用。

1　区域地质概况

二连盆地位于亚洲板块与西伯利亚板块的缝合带上，为发育在内蒙古—大兴安岭海西褶皱基底上的中、新生代沉积断陷盆地，面积约为0.1×10^6 km^2。其由8个二级构造单元组成，分别是马尼特坳陷、乌尼特坳陷、乌兰察布坳陷、川井坳陷和腾格尔坳陷，以及中部的苏尼特隆起、北部巴音宝力格隆起和南部温都尔庙隆起，整体呈三隆夹五坳的构造格局。盆地内构造多呈北东和北北东向展布，具有分割性强、多凸多凹的特点，已发现54个凹陷和21个凸起。研究区构造样式具有典型的拉张型特征，形成单断式和双断式2种凹陷结构。凹陷内沉积地层以下白垩统阿尔善组（K_1ba）、腾格尔组和赛汉组为主，受区域构造沉积演化控制，阿尔善组沉积早期为研究区第1次湖侵期，腾一段（K_1bt_1）沉积时期为湖盆发育期，形成阿尔善组和腾一段2套主力烃源岩层。研究区各凹陷内一般发育1～2个主力生油洼陷，控制着油气的平面分布。

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2　沉积砂体分布主要控制因素

2.1　古物源

在沉积物从剥蚀、搬运到沉积的诸多因素中，古地貌是贯穿始终的关键因素[12]；对于断陷湖盆，古地貌对物源供给和沉积体系的分布具有明显的控制作用。湖盆周缘的古凸起和古高地是主要的物源供给区，湖盆内古高地和横向构造带是次要的物源供给区；其共同提供丰富的沉积物来源，控制了沉积体系及沉积砂体的分布。

2.1.1　古高地

在区域构造运动的控制下，紧邻凹陷陡坡带和斜坡带的古高地（古凸起）通常遭受较强烈的抬升剥蚀作用，可以提供大量的沉积物来源。同时，古高地又对古水系具有阻挡和分割作用，而与其相对应的古沟谷负地貌则是主要的沉积物供给通道，尤其是与凹陷湖盆区相连通的大山口和古沟谷的出口往往是主要的物源供给口。例如在阿尔善组沉积初期，二连盆地阿南凹陷哈南地区的哈南潜山已形成雏形，受早期断层控制，发育北北东向展布的古高地（或古岛屿）；由于其长期抬升遭受剥蚀，成为哈南地区重要的物源供给区。

2.1.2　横向构造带

横向构造带是指与区域构造走向垂直或大角度斜交的构造带，通常为一个复杂、不规则的构造带，也称为传递带、变换带、调节带或转换带。二连盆地断陷凹陷具有伸展特征，其横向构造带主要为处于不同沉积中心（洼槽）之间、具有转换或调节作用的构造带，与陡坡带、洼槽带和斜坡带的构造走向垂直或斜交，通常在构造特征上表现为形成时间较早的断裂构造带。横向构造带与相邻洼槽带存在较大的地形高差，可以作为主要的物源供给区，并对来自其他物源区的沉积物起到明显的控制作用。例如在乌里雅斯太凹陷南洼槽陡坡带一侧发育太11南横向构造带，该构造带受南、北2条背向平行断层控制；其中北部断层的规模较大，在阿四段—腾一段沉积时期继承性发育，其下降盘地层沉积厚度大，存在充填特征，并具有向太11南横向构造带侧翼明显超覆减薄的现象；表明受构造带控制，在其北部发育物源供给通道，控制了沉积砂体的展布。从乌里雅斯太凹陷南洼槽腾一段下亚段沉积相分布可以看出（图1），太11南横向构造带北侧发育扇三角洲沉积体系，并向洼槽深部推进，形成凹陷东部陡坡带的沉积砂体局部发育区。

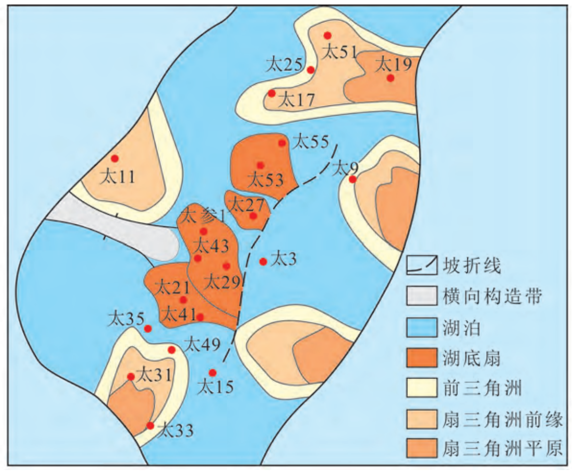

图1　二连盆地乌里雅斯太凹陷南洼槽腾一段下亚段沉积相分布

2.2　古沟谷

在断陷湖盆的沉积演化过程中，运载沉积物的各种水系总是从高势区向低势区流动，最终汇聚到凹陷深部或洼槽带。古沟谷是与物源供给方向一致的、多呈条带状延伸的低凹地貌，为沉积物的主要运载（搬运）路径或通道，对沉积体系的分布具有重要的控制作用。研究表明，这种控制水系的古沟谷可以表现出多种形式，作为物源输导通道主体的下切谷、河道、水下滑塌（重力流）水道、水下冲蚀河道等，构成凹陷内沉积卸载区的大山口、河道和沟谷的出口，沿湖盆边缘陡坡带呈局部凹形的缺口等。作为搬运通道的古沟谷可以出现在物源区、冲积平原区、陡坡带、缓坡带和洼槽带，其共同作用形成了凹陷内复杂的沉积物搬运输导通道。古沟谷的发育部位不同，对沉积体系的控制作用也存在差异。远离洼槽带的古沟谷主要起着搬运沉积物的作用；而紧邻或位于洼槽带的古沟谷，在作为搬运通道的同时，也可以作为卸载区，成为沉积砂体的主要发育区。

在阿南凹陷南部斜坡带，古沟谷对沉积砂体具有明显的控制作用。在腾格尔组沉积早期，阿南凹陷南部斜坡带发育两洼夹一凸的古构造格局，在哈南—吉和潜山构造带两侧发育2个古沟谷，成为沉积砂体的主要运载通道。在古沟谷发育位置，腾一段沉积厚度明显变大，并向两侧减薄，表明古沟谷位置是地层的主要沉积区。沉积相分布也表现出相似的特征，来自南部物源区的沉积砂体主要以古沟谷为搬运通道和卸载区，古沟谷成为扇三角洲砂体的主要沉积区（图2）。

在区域差异性升降构造作用控制下，断层发育是二连盆地断陷湖盆主要的构造特征。对于控凹

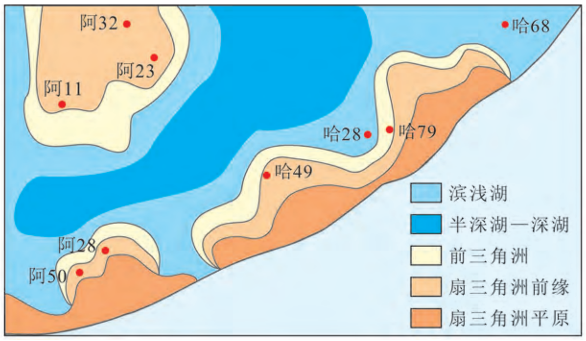

图2 二连盆地阿南凹陷南部斜坡带腾一段沉积相分布

断层，其产状变化决定了沉积体系进入湖盆的位置；断面凹槽部位通常具有较大的可容纳空间，成为沉积物进入湖盆的主要通道，大量的碎屑物质经陡坡带边界的断层凹槽处进入湖盆，在其下降盘形成（扇）三角洲砂体或近岸水下扇砂体[13]。对于2条以上断层相交的陡坡带，其交接处往往断距较小，地层坡度较缓，也是沉积物进入湖盆的主要搬运通道。在巴音都兰凹陷南洼槽陡坡带，受控凹边界断层产状的控制，在巴Ⅰ号构造和巴Ⅱ号构造发育2个古沟谷，成为沉积物的主要入湖位置，沿陡坡带形成2个大型的扇三角洲沉积体系。当边界断层表现为多段斜列式时，相邻2条断层之间的调节带通常成为沉积物的主要搬运通道，如在赛汉塔拉凹陷东部陡坡带，多条控凹断层斜列分布，其间的调节带成为三角洲砂体入湖的主要通道。

2.3 坡折带

二连盆地断陷湖盆主要表现为单断结构，个别为双断结构。湖盆通常呈长条形或狭长状展布，顺湖盆走向的长源沉积体系不发育或发育程度很弱，主要发育来自陡侧和缓侧、垂直湖盆构造走向的两大物源供给区。湖盆内的坡折带既是物源水下供给通道又是可容纳空间分布区[14]，对沉积砂体的分布具有重要的控制作用。综合二连盆地坡折带发育特征，可以划分出2类7种坡折带类型；依据坡折带的发育部位，可以划分为陡坡坡折带和缓坡坡折带；依据成因机制和断层产状，可以将陡坡坡折带划分为板式陡断裂坡折带、板式缓断裂坡折带和断阶坡折带3种类型，缓坡坡折带划分为缓坡断裂坡折带、缓坡挠曲坡折带、缓坡沉积坡折带和缓坡侵蚀坡折带4种类型。沉积砂体的分布、叠合方式及规模明显受不同类型坡折带的控制。

2.3.1 陡坡坡折带

在断陷湖盆的陡坡带一侧以发育控凹单边界断层或断阶带的二台阶断层为特征，受其控制易于形成不同类型断裂坡折带。在断裂坡折带发育处，往往存在明显的构造转折和地形变化，在其下部形成加大的可容纳空间；因此，以上部古沟谷作为主要的沉积砂体搬运通道，沉积物在断裂坡折带快速卸载和沉积，成为陡坡带沉积砂体的主要发育区。

板式陡断裂坡折带　板式陡断裂坡折带的断面平直，呈板状，产状较陡，倾角一般大于60°；由于坡度陡、高差大，近物源的沉积物在板式陡断层下降盘快速卸载堆积，搬运距离短，沉积物颗粒粗、分选差，造成沉积类型单一，以近岸水下扇和冲积扇为主。如吉尔嘎朗图凹陷西部陡坡带，其西部以板式陡断层与凸起分割，来自凸起的近源沉积物快速沉积，形成水下扇沉积体系。水下扇沉积体系的平面分布范围较窄，沿陡坡带断层呈扇形或多期条带状分布，宽度为1～2 km；垂向上表现为加积层序，单层及累积厚度较大，且岩性混杂、期次不明显，缺乏中间隔层。

板式缓断裂坡折带　与板式陡断裂坡折带相比，板式缓断裂坡折带的断面平直，倾角相对较缓，约为40°～50°。在板式缓断层的控制下，可容纳空间相对较大，沉积砂体仍以快速卸载为主，具有一定的分选性，易于形成扇（辫状河）三角洲沉积体系。二连盆地西北部的阿尔凹陷具有东断西超的箕状结构特征，东部陡坡带边界断层为规模较大的板式缓断层，受其控制来自东部物源区的沉积砂体卸载后，形成辫状河三角洲沉积体系。阿尔2井单井沉积相分析显示，其具有中厚层状砂砾岩夹薄层泥岩组合特征；岩心观察可见多层明显的冲刷面、交错层理和反粒序递变层理；颗粒分选、磨圆较好，杂基、颗粒混合支撑，反映为水动力条件较强的辫状河三角洲前缘水下分流河道沉积。

断阶坡折带　断阶坡折带是指在陡坡带边界主断层控制下形成多条派生或次生断层，沿断层倾向形成断阶形态组合。在其控制下，古地貌表现为向洼槽中心区逐渐变低，构成具有一定宽度的断阶构造带。来自陡坡带的沉积物存在较长距离的运移，沉积体系分布范围可超过10 km，砂体分选较好，沉积类型丰富。断阶坡折带在额仁淖尔凹陷东部陡坡带较为发育，其断阶高部位沉积厚度较薄，主要发育阿尔善组和腾格尔组，赛汉塔拉组基本被剥蚀殆尽；其中阿尔善组主要发育扇三角洲平原辫状河水道沉积，腾格尔组一段主要发育水下扇沉积。断阶低部位的可容纳空间和沉积厚度较大，地层发育较全，主要发育大型扇三角洲前缘和滑塌扇沉积；特别是在阿尔善组沉积时期，扇体发育规模较大，地震剖面上可见较明显的前积现象。

2.3.2　缓坡坡折带

缓坡断裂坡折带　缓坡断裂坡折带的断层发育程度一般弱于陡坡断裂坡折带，通常具有多级坡折带的特点；其沉积相带分布较宽，可发育较大规模的扇（辫状河）三角洲、下切谷水道和湖底扇等。如在乌里雅斯太凹陷南洼槽斜坡带太41井区，自斜坡带向洼槽带方向，由太45东、太41东等断层形成多级断裂坡折带（图3），控制着该区腾格尔组沉积体系的分布；来自斜坡上倾方向的沉积物进入湖盆后易发生再搬运作用，形成扇三角洲—湖底扇沉积体系，沉积砂体横向展布范围较大。

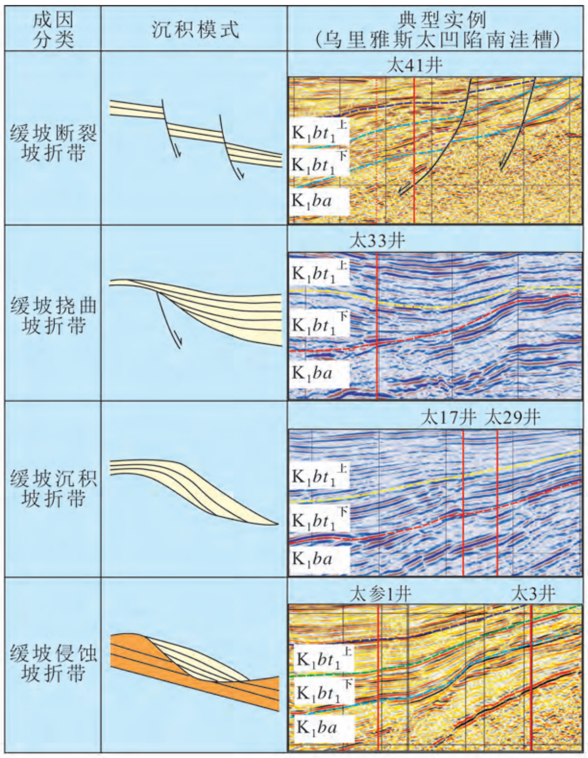

图3　二连盆地断陷湖盆缓坡坡折带分类与主要特征

缓坡挠曲坡折带　缓坡挠曲坡折带是由于深部隐伏断裂活动使浅部地层发生挠曲变形或同沉积褶皱活动形成的背斜、鼻状构造的两翼发生挠曲而产生的。其主要特征为坡度突变，在坡折带下部有明显的上超和地层增厚现象（图3），在坡折带上部可见地层削蚀。如乌里雅斯太凹陷南洼槽斜坡带南部超尔金鼻状构造北翼的太33井区，受阿尔善组沉积末期形成的缓坡挠曲坡折带控制，在坡折带中、下部地层明显超覆减薄，坡折带顶部地层削蚀，形成了腾一段下亚段扇三角洲沉积。

缓坡沉积坡折带　缓坡沉积坡折带主要是由于同一构造区域不同沉积速率和压实作用造成的地形坡度突变，也可以由缓坡断裂坡折带演化形成[15]。在三角洲平原和三角洲前缘的结合部位一般可形成缓坡沉积坡折带[16]，其沉积砂体往往表现为前积特征。在乌里雅斯太凹陷南洼槽斜坡带的太17井区，腾一段沉积初期为填平补齐沉积，随着水域扩大，形成三角洲沉积体系；受差异压实作用影响，形成缓坡沉积坡折带（图3）；向下倾方向，为具有明显前积特征的扇三角洲前缘沉积，水下河道发育，沉积砂体平面分布范围较大。

缓坡侵蚀坡折带　缓坡侵蚀坡折带是由风化侵蚀等外动力地质作用造成的地形坡度突变，在持续时间较长但侵蚀还未达到准平原化的不整合面下可能发育缓坡侵蚀坡折带。其发育较广泛，成盆早期长期发育的不整合面的地形突变、湖盆发育晚期地层遭受抬升剥蚀或潜山顶面不整合造成的地形变化均可形成缓坡侵蚀坡折带。其与下伏地层为剥蚀不整合接触，在缓坡侵蚀坡折带控制下形成的沉积为充填沉积。乌里雅斯太凹陷南洼槽太参1井区发育较为典型的缓坡侵蚀坡折带，在斜坡背景上，阿尔善组沉积末期形成区域性不整合，遭受侵蚀形成低凹地形，对腾一段沉积早期砂体的发育具有明显的控制作用；其沉积砂体表现为下切充填状，具有上凹下凸的透镜状外形（图3）。

3　结束语

二连盆地具有断陷湖盆多、湖盆范围小、水体浅、近物源、沉积类型多及相带横向变化快的特点。通过对其沉积砂体形成过程的研究可知，古物源、古沟谷和坡折带共同控制断陷湖盆沉积砂体的分布。古物源控制沉积物的入湖位置及沉积体系分布，在断陷湖盆周缘与古高地对应的古沟谷是主要的物源供给通道，也是沉积物入湖的位置，断陷湖盆内古高地是次要物源供给区。侵蚀古沟谷以及控凹断层等形成的古沟谷是沉积砂体主要的搬运路径（通道）。断陷湖盆内的坡折带是沉积砂体分布的主要控制因素，将二连盆地坡折带划分为陡坡坡折带和缓坡坡折带等2类7种，不同类型坡折带控制沉积体系的类型及砂体的分布与叠合方式。

随着二连盆地勘探开发的不断深入，地层岩性油藏成为勘探的主体，寻找有利沉积砂体成为一项重要的研究内容。下一步应在宏观沉积体系形成与分布研究的基础上，加强高分辨率层序地层分析，深化不同类型沉积砂体储层预测技术与敏感性参数的优选、推进储层预测由定性向半定量—定量方向的发展，从而实现对沉积砂体空间分布的精细

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刻画,为寻找研究区地层岩性油藏的有利勘探方向及目标评价优选提供依据。

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uration median radius, the maximum pore throat radius, the average pore throat radius, as the pore volume ratio and the percentage of non-saturated mercury pore volume), using K-Means clusterting analysis method, the conglomerate reservoir is divided into four major categories of class I, II, III and IV, which are on behalf of the reservoir good, moderate, poor and very poor, then, each type of reservoir pore structure characteristics is summarized. The analysis of the main factors, affecting the pore structure, shows that the factors affecting the pore structure are tectonic, sedimentation and diagenesis. The influence of deposition on the pore structure is mainly characterized by the lithologic control on the physical properties of the reservoir, and for diagenesis on pore structure, mainly by compaction resulting in lower average porosity; and the cementation deteriorates the pore structure and physical properties; meanwhile, the secondary porosity generated by dissolution improves the reservoir pore structure and physical properties; however, the authigenic euhedral crystal mineral by recrystallization filled or partially filled in the intergranular porosity and throat has reduced the porosity by narrower throat and poorer pore connectivity; the pressure solution can generate pressure solution seam, suture, or dissolved pores so as to expand the pore space. The research results provide the basis for the formulation of oil field development decision-making and stimulation.

Key words: conglomerate reservoir; pore structure; pore type; influence factors; lower Karamay formation; Karamay oilfield

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Zhao Lei, Sun Qiang, Ji Jianqing et al. Hydrocarbon-generating potentials analysis on late Paleozoic residual ocean basin in West Junggar. *PGRE*, 2013, 20(6): 35-37

Abstract: The hydrocarbon-generating potentials of residual ocean basin get more and more attention. Based on the fact that the Junggar basin is underlain by the Precambrian continental block, an upper Paleozoic residual ocean might exist in west Junggar and aast Kazakhstan named the Balkhash-West Junggar residual ocean. Bole-Ebinur Lake sag lies in the south margin of the basin. Many sets of source rocks composed of upper Devonian-lower Carboniferous mudstone, marlstone and biolithite limestone are discovered from Bole-Ebinur Lake sag in southwestern margin of basin. The average *TOC* of source rocks is 2.19%, and the maximum is 7.11%. And, more close to oil-soaked clastic rocks in Bole-Ebinur Lake sag, the saturated hydrocarbon of source rock extract shows bimodal distribution type with odd-carbon predominance. According to light-to-heavy carbon-number ratios and asphaltenes contents, the upper Paleozoic source rocks well-preserved in the basin are still in a medium mature stage with high hydrocarbon-generating potentials.

Key words: residual ocean basin; source rock; hydrocarbon-generating potential; Bole-Ebinur Lake sag; Junggar basin

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Xu Guihua. Reservoir risk assessment methods on stratigraphic traps, Jiyang depression. *PGRE*, 2013, 20(6): 38-41

Abstract: In this stage, the stratigraphic traps in Jiyang depression is low in success rate of exploratory wells, and pre-drilling risk is difficult to predict. Through the analysis and summary of wells drilled in the "Tenth Five-Year", the failure of the exploration well is attributed to poor transportation conditions, low filling of oil-gas in reservoir, lack of effective reservoirs and traps, at 49%, 21%, 15% and 15% respectively. The reservoir analysis shows that the positive structural background and the neighboring oil-source fault is the key stratigraphic trap reservoir. Based on the analysis herein, the geological conditions influencing the accumulation of stratigraphic reservoir are mainly migration and accumulation, storage, trap and reservoir property. According to the evaluation of the geological conditions of stratigraphic traps in Jiyang depression, we establish the pre-drilling risk assessment method for stratigraphic trap, and then it is tested and verified. The results show that the evaluation results accords well with the actual drilling results, and the well of Jinping2, Chengdong112 with higher geological risk are all hydrocarbon accumulated, but the well of Chengdong111, Wang951 and other wells with low geological risk are not hydrocarbon accumulated.

Key words: stratigraphic traps; exploration well success rate; reservoir forming risk; assessment methods; Jiyang depression

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Wang Quan, Li Xiaohong, Zhao Xuan et al. Main controlling factors of sedimentary sandbodies distribution in fault sag, Erlian basin. *PGRE*, 2013, 20(6): 42-45

Abstract: The Erlian basin is consisted of a group of middle Mesozoic and Cenozoic small fault lake basins, and it is geologically favorable for the formation of stratigraphic-lithologic reservoirs. Considering that these fault lake basins are characterized by small size, multiple sources, rapid deposition and abrupt facies belt change, this paper focuses on the formation process of sedimentary sandbodies distribution and analyzes the key factors controlling of sandbodies in terms of source material supply, transport pathway and sandbody distribution by means of research techniques of palaeostructure analysis, seismic sedimentary facies analysis and typical sedimentary sandbody analysis. It is indicated that the key factors controlling sandbodies distribution are the ancient material source, ancient valleys and slope breaks. Entry position and distribution of depositional systems are controlled by the sag margin and the internal ancient highlands. The transport pathways of sandbodies within the lake basins are controlled by ancient valleys formed by sag-controlling faults. In different types of slope break zones, the sandbodies present different characteristics of superposition and distribution. The ancient material source, ancient valleys and slope breaks in fault sags are influenced mutually and have a significant effect on the formation and distribution of sandbodies jointly.

Key words: stratigraphic-lithologic reservoir; sedimentary sandbody distribution; controlling factors; fault sag; Erlian basin

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Li Ye, Zheng Deshun, Tang Jie. Integrated geophysics research on distribution of turbidite sand body in E_2s_3, Binnan oilfield. *PGRE*, 2013, 20(6): 46-50

Abstract: The E_2s_3 formation of Binnan oilfield is developed in basin rift epoch. Because of the adequate sediments, many kinds of turbidite sediment reservoirs are developed. However, due to the restriction of seismic data's quality and facies change, great progress has not been made in the exploration of turbidite reservoirs in Binnan oilfield. This paper aims at practical problems of turbidite reservoirs identification and introduces a workflow: establishing sequence framework-analyzing seismic response characteristics (amplitude, continuity etc.)-attribute analysis with strata slice-spectral decomposition-log-constrained seismic inversion, and the issues above are perfectly solved. According to the seismic response, log and drilling characteristics, this paper divides the E_2s_3 formation into three sequences, and the turbite reservoirs is mainly developed in mid E_2s_3 & lower E_2s_3; the favorable turbidite reservoirs development sites are anticipated by using 90° phase rotation, strata slice and instantaneous amplitude technology, the result shows that the turbidite reservoirs is mainly developed in southeast and the neighboring areas of Binxian prominence; by application of S-Transformation, the initial seismic data is decomposed into 25, 30, 35, 40 and 45 Hz single-frequency data-bodies, among which, the 40 Hz single-frequency data-body shows a better resolving ability of turbidite reservoirs; and then, in combination with the log-constrained seismic inversion and 40 Hz single-frequency data-body, the vertical overlap features of turbidite sandbodies are clear, and favorable development sites of turbidite reservoirs are proposed.

Key words: turbidites; reservoir prediction; phase transformation; strata slice; optimal attribute analysis; spectral decomposition; logging constrained inversion

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Han Bo, Jia Hongyi, Li Guodong et al. Application of 3D restoration to predicting fractures in special lithologic body-case study of Shang541 region, Huimin sag. *PGRE*, 2013, 20(6): 51-53

Abstract: Most of the fracture prediction methods are based on the present geological structure characteristics, without considering the effect of multi-stage tectonic movements, especially the effects of the fault shape on strata in hanging wall. Using the Plane Model in 3DMove software, the method based on 3D restoration is applied to calculate the present accumulative strain and predict fractures, in the middle E_2s_3 intrusive rocks of Shang541 region, Huimin sag. The principal curvature of the top of intrusive rocks is also calculated. With reference to the porosity and permeability data of two wells, the fracture prediction result by 3D restoration is contrasted with that by curvature method. It shows that the 3D restoration method is highly applicable to the fracture prediction in special lithologic body, such as intrusive rocks, of which the curved surface is not formed totally by tectonic deformation.

Key words: fracture prediction; 3D structural restoration; intrusive rocks; curvature attribute; Shang541 region

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Qu Zhanqing, He Limin, Dou Xiaokang et al. Inflow performance analysis and optimization of artificial lifting for horizontal wells in low permeability reservoir. *PGRE,* 2013, 20(6): 54-60

Abstracts: Inflow performance and optimization of artificial lifting way for horizontal wells in low permeability reservoir is the key to develop the horizontal wells for low permeability reservoir. Based on the classic Giger capacity formula, and adopting the hydropower similar principle and conformal mapping method to derive the productivity model and inflow performance equation of the hypotonic non-Darcy horizontal wells, the model has a higher accuracy after the field application verification, and the capacity influencing factors sensitivity of horizontal wells in low permeability reservoir is then analyzed. The analysis indicates that the horizontal well inflow performance variation is basically not affected by starting pressure gradient; and keeping pressure is the key to improve the efficiency of low permeability horizontal wells, the starting pressure gradient, permeability and coefficient of variation of the viscosity of the fluid are inversely proportional to liquid production, and the lower the pressure, the more obvious the effect; for the horizontal section length within 400 m, the ultimate production increases linearly with the horizontal length, the production drops and finally stabilized beyond 400 m; we use the equivalent weighting method and analytic hierarchy process to establish the lifting way preferred model, and the best lifting way of field wells is the electric submersible pump lifting.

Key words: low permeability reservoir; horizontal wells; inflow status; lifting way; analytic hierarchy

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