

义东油田义东断裂带成藏规律分析

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摘要 受义东断裂带控制,四扣洼陷北部发育了多种类型油气藏,且义东断裂带南北构造差异明显,造成成藏模式存在较大差异。研究义东断裂带成藏条件及成藏规律,对该区的进一步油气勘探具有重要的意义。根据岩心、录井、钻井、地震等资料,对四扣洼陷义东断裂带成藏条件及成藏规律进行综合研究。结果表明,与义东断裂带相邻的四扣洼陷沙三、四段具有丰富的烃源岩条件、良好的储盖组合及封闭性,成藏条件十分优越。义东断裂带发育有多个岩性及构造-岩性油气藏。油藏具有沿断裂带分布及“浊积扇”式等特征。其中沙四段油气成藏特征为南部断阶带以礁灰岩储集层形成的岩性油藏,北部为碎屑岩储集层形成的构造-岩性油藏;沙三段发育小規模近岸水下扇、浊积扇构造-岩性油藏和浊积水道砂体岩性油藏;沙二段发育扇三角洲和砂质滩坝,常形成构造-岩性油藏。

关键词 四扣洼陷;义东断裂带;成藏条件;成藏模式

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Reservoir Patterns of Yidong Fault Zone in Yidong Oilfield

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Abstract Under the control of Yidong fault zone, many kinds of oil reservoirs are formed in the north of Sikou sag. Meanwhile, because of the significant tectonic differences exist between the north and the south structures of Yidong fault zone, the reservoir-forming patterns are quite different. Therefore, studying reservoir-forming conditions and patterns has the important significance for further hydrocarbon exploration. Based on the data of core, well logging, well drilling, and seismic analyses, the reservoir-forming conditions and patterns of Yidong fault zone are discussed. The results show that due to abundant source rocks, good reservoir-cap assemblage, and sealing property, the reservoir-forming conditions are quite superior, and many lithologic reservoirs and structural lithologic reservoirs are formed, that have the pattern feature of "turbidite fan" and distribute along the faulted zone. The feature of the fourth member of Shahejie Formation (E_{s4}) are that the reef limestone lithologic reservoirs are developed upon the south fault terrace, and clastic structural lithologic reservoirs are formed in the north part. In the third member of Shahejie Formation (E_{s3}), some small nearshore subaqueous fan, turbidite fan structural lithologic reservoirs, and turbidite channel lithologic reservoirs are developed. Nevertheless, fan delta and sandy beach bar structural lithologic reservoirs are mainly developed in the second member of Shahejie Formation (E_{s2}).

Keywords Sikou sag; Yidong fault zone; reservoir condition; reservoir pattern

0 引言

勘探数据表明义东地区义东断裂带沙三、四段发育了岩

性圈闭、构造-岩性圈闭、构造圈闭等多种圈闭类型,已发现的油藏类型以构造和构造-岩性为主。成藏的关键因素取决

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③ 同沉积断层的发育往往造成斜坡带地形的突变,在断层的下降盘坡度变缓处水流速度降低,河流携带的泥砂极易堆积形成各种各样的扇体,成为良好的储集体。对于本区沙河街组受断层影响的构造、岩性-构造和构造-岩性圈闭而言,断层活动性对油气成藏起到关键作用,本区最大的断层——义东断层从沙四沉积时期开始活动,沙三、沙二、沙一阶段活动性很强,沙一时达到最大,自东营组沉积时期义东断层的活动性逐渐减弱(图2),而渤南、四扣洼陷排烃是从东营晚期开始,于馆陶、明化镇组沉积时期达到最大,因此义东断层在油气大规模运移之前活动性减弱,对油藏起保存作用。

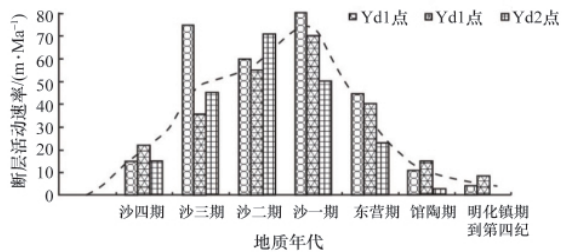


图2 义东断层活动速率随时间变化直方图

Fig. 2 Histogram for the activity of Yidong fault rate changing with the time

2.4 侧向封堵作用

沙三、四段的水下扇体沉积物粒度小、物性好,即使在扇根部位仍具有良好的渗透性,因此成藏的关键取决于义东断层上升盘对接的古生界地层是否形成侧向封堵。扇根部位通过义东断层与义和庄凸起的太古界和古生界地层相接,为致密的非渗透层,能够形成侧向封堵,在义东断裂带下降盘高部位形成构造-岩性油藏。如义深7井在沙四段的水下扇根钻遇了5.86t/d工业油流,向西以义东断层对接太古界致密的花岗岩或花岗片麻岩,对油气形成良好的侧向封堵而成藏(图3)。

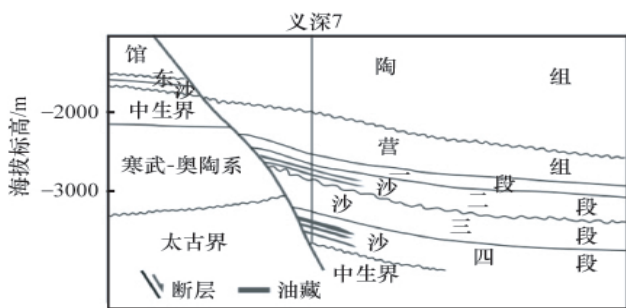


图3 断层上盘对接地层的封堵性与缓坡水下扇成藏的关系

Fig. 3 Relationship between the plugging property of docking strata in the up wall of faults and the gentle slope underwater fan reservoirs

3 成藏特征

义东断裂带断距较大,并伴生多个台阶断层,断裂带向

东发育了多条东西向小断层和沟道。义东断裂带沙河街组在此背景下发育有多个岩性及构造-岩性油气藏。油藏具有沿断裂带分布及“浊积扇”式等特征。

3.1 沿断裂带条带状展布

义东断裂带与其他陡坡带相比,储层发育程度较低,尤其是碎屑岩储层数量较少,沉积相带规模较小,往往就近在义东段下降盘堆积,延伸距离较小,基本在2~3km内,这就造成油藏沿义东断裂带呈条带状展布,并在垂向上呈叠合连片的特点(图4)。

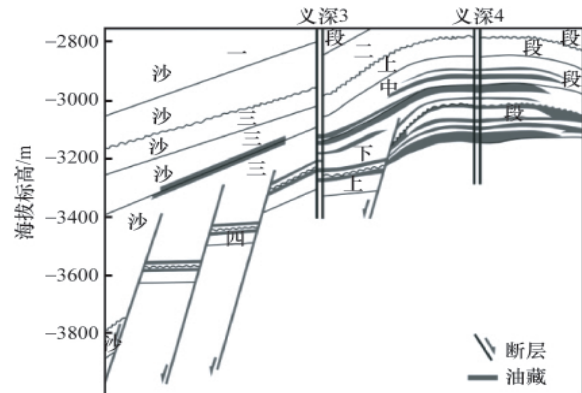


图4 沿义东断裂带沙三、四段南北向油藏剖面

Fig. 4 Profile of reservoir from north to south in the Es₃ and Es₄ along the Yidong fault zone

3.2 类似于“浊积扇”式成藏特点

义东断裂带沙三、四段发育的近岸水下扇扇体不大,扇根、扇中物性好,薄层砂岩被厚层泥岩和油泥岩包围,具有丰富的油源条件和充注条件,同时厚层泥岩和油泥岩又可作为优良的盖层,因此,义东断裂带水下扇利于形成岩性构造油藏和岩性油藏,使得义东断裂带储层具有类似于“浊积扇”式的成藏特点(图5)。

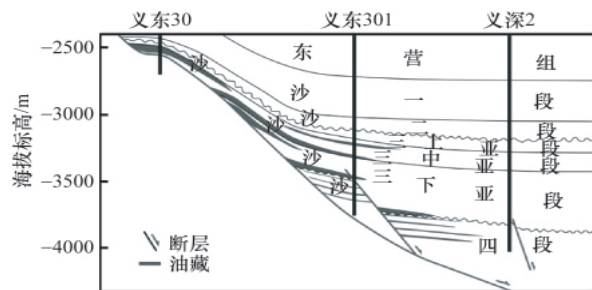


图5 义东断裂带沙三、四段东西向油藏剖面

Fig. 5 Profile of reservoir from east to west in the Es₃ and Es₄ along the Yidong fault zone

3.3 沙二段为断层、储层控制的构造岩性油藏

义东地区沙二段受沉积影响,主要形成水下扇和滨浅湖相沉积,砂岩滩坝、砂砾岩储层比较发育,油藏受控于断层和岩性,在好储层和断层发育处富集(图6)。

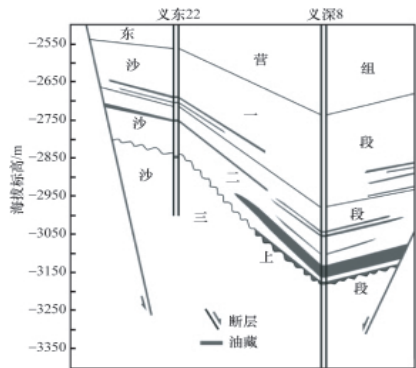


图 6 义东 22-义深 8 井沙一、二段东西向油藏剖面
Fig. 6 Profile of reservoir form east to west in the Es₁ and Es₂ of well Yidong 22 and well Yishen 8

4 成藏模式

四扣洼陷生成的油气在义东断裂带聚集成藏,由于断裂带南部和北部构造存在差异,这就造成沉积相带和成藏模式有很大不同。

义东断裂带南部成藏模式(图 7):① 受不整合面控制的地层圈闭油藏;在断层上升盘,古近系地层超覆于古地貌之上,可形成地层超覆油藏;② 受断层及潜山控制的潜山油藏和内幕层状油藏;③ 古近系地层沿台阶断层发育多期水下扇体,沙四段发育礁灰岩,可形成礁灰岩等岩性油藏、构造油藏和构造-岩性油藏。

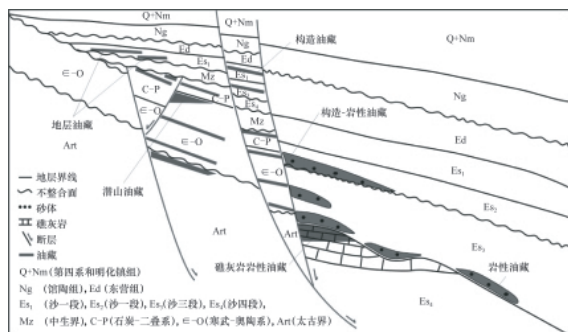


图 7 义东断裂带南部成藏模式图
Fig. 7 Reservoir patterns in the southern area of Yidong fault zone

与断裂带南部相比,义东断裂带北部成藏模式有很大不同,由于缺少二台阶断层对沉积和成藏的控制作用,北部古近系只沿台阶断层发育多期水下扇体,可形成构造-岩性油藏(图 8)。

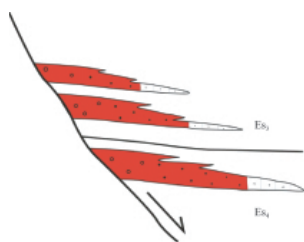


图 8 义东断裂带北部成藏模式图
Fig. 8 Reservoir patterns in the northern Yidong fault zone

5 结论

(1) 义东断裂带具有良好的成藏条件。构造活动一方面促使储集层孔裂隙发育,增强储集性能;另一方面,在油气大规模运移之前构造活动性减弱,对油藏起保存作用。义东断层西部对接太古代致密的花岗岩或花岗片麻岩,对油气形成良好的侧向封堵而成藏。

(2) 义东断裂带南北构造差异明显,造成沉积相带和油气聚集成藏模式有很大不同。义东断裂带南部成藏模式有潜山油藏、地层油藏、礁灰岩岩性油藏、构造油藏及构造-岩性油藏等。北部古近系沿台阶断层发育多期水下扇体,可形成构造-岩性油藏。

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