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鄂尔多斯盆地海相碳酸盐岩层系天然气成藏研究

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摘要:

鄂尔多斯盆地两套优质烃源岩,即上奥陶统背锅山组泥灰岩和中奥陶统平凉组中下部页岩,是海相碳酸盐岩层系古油藏原油和现今靖边气田油型气的主要来源。两套优质烃源岩主要分布在盆地的西部和西南部,呈"L"型展布,盆地内部缺失;它们累计厚度约50~350m。平凉泥岩TOC介于0.5%~1.2%,平均0.9%,厚度20~50m,而灰岩TOC主要分布在0.2%~0.4%区间,平均0.3%。背锅山组泥岩有机碳相对较高,TOC介于0.22%~3.3%,平均为0.93%。三叠纪末期,两套优质烃源岩生成的大量液态烃类进入中央古隆起控制的斜坡部位,形成古油藏;侏罗纪-早白垩世,地层持续加深和地温梯度升高,烃源岩热演化程度达到高-过成熟阶段,古油藏温度超过180℃,原油开始热裂解生成天然气。油气的热裂解导致气藏压力不断增大,驱使部分气体进一步扩散运移。晚白垩世燕山运动IV幕,盆地东部大规模持续挤压抬升导致了原有油气藏经历了西高东低转变为东高西低的构造反转,形成构造枢纽。中央隆起带聚集油气的优势被改造,裂解形成的天然气向东或东北方向运移。但是运移过程中,东部盐岩、膏盐、致密碳酸盐岩侧向封堵。在靖边气田中心部位,由于奥陶系顶部缺失石炭系铁铝土岩封盖,使得部分石炭-二叠系生成的天然气沿着不整合面进入风化壳,形成从奥陶系来源的原油裂解气与石炭-二叠系生成的煤型气相混合。

英文摘要:

Two sets of high quality marine source rocks in Ordos basin, including Upper Ordovician marl in Beiguoshan Formation and Middle Ordovician shale at middle and bottom parts of Pingliang Formation, were a progenitor of the past crude oil in marine carbonate reservoir and present oil-type gas which was sourced from oil cracking in Jingbian gas pool. Two sets of marine source rocks were distributed in the west and southwest of Ordos basin as "L" shape and absent in internal basin, with thickness of about 50~350m. TOC value in Middle Ordovician Pingliang shale is in range of 0.5%~1.2% (average value=0.9%), and Pingliang limestone has TOC value of 0.2%~0.4% (average value=0.3%). TOC value in Upper Ordovician Beiguoshan source rock is more than that of Pingliang source rock, with TOC value of 0.22%~3.3% (average value=0.93%). At end of Triassic, crude oil generated from two sets of high quality marine source rocks was migrated into the slope of Central Paleouplift and accumulated as an oil pool. At period of Jurassic and Early Cretaceous, large buried thickness and increasing geothermal gradient made not only high-over maturity of marine source rocks, but also temperature of oil reservoir more than 180℃, and then the early crude oil started thermally cracking into natural gas. Increase of gas reservoir pressure which was formed by thermal cracking of oil and gas pushed natural gas diffused. At the IV episode of Yanshan Movement (corresponding to Later Cretaceous), large scale continuous extrusion and uplift in the eastern part of Ordos Basin caused the structural reversion of gas reservoir from west high and east low to east high and west low, that is called as structural hinge. Thus, the predominance of oil and gas accumulation in the Central Paleouplift was changed. Oil cracking gas was migrated toward east or northeast, but gas was laterally blocked by salt, gypsum and fine carbonate in the eastern basin. The Carboniferous bauxitic mudstone beneath the unconformity/coal measure acts as an important cap rock. The coal-type gas sourced from the Carboniferous-Permian humics is believed to diffuse and migrate through the unconformity and mix with gas generated from secondary cracking in Ordovician paleo-weathering crust due to the incomplete distribution of bauxitic mudstone in the central part of Jingbian gas field.

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