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Genetic mechanisms of high quality reservoirs in the ‘multi-stage subsidence-uplift’ Permian sandstones in Bohai Bay Basin, East China

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Following a huge success in North America, hydrocarbon resources in Permian are now being actively explored world-wide. High quality sandstones reservoirs developed in Permian of Bohai Bay Basin, after several periods of subsidence and uplift. For effective exploration from such a complex reservoir, the genetic mechanism must be thoroughly studied first. The sandstones have been examined by a variety of methods, including core and thin section observation, CL, SEM, XRD, fluid inclusions and isotope testing, mercury penetration etc. Pore water data was collected from the oilfield company. Combined with the histories of burial evolution, and organic matter thermal evolution, genetic mechanisms of high quality reservoirs in Permian of Bohai Bay Basin were investigated. The results show that the reservoir in Permian of Bohai Bay Basin is characterized by high compositional maturity and relatively high textural maturity. Dissolution of feldspar and precipitation of authigenic kaolinite, quartz characterized the digenesis. The porosity types is mainly secondary pores and intercrystalline pores in authigenic kaolinite. The sandstones are mainly low-permeability rocks to tight rocks, which exhibit a wide range of porosity from 0.11% to 21.3% and permeability from 0.001 to 1270 md. Burial-thermal histories of Permian of Bohai Bay Basin are divided into three types, the first type has experienced two periods of long-term subaerial exposure, the second type has experienced one period of long-term subaerial exposure, the the third type has never experienced long-term subaerial exposure. During the long-term subaerial exposure, freshwater intruded into the inclined sandstone beds and the minerals were leached, which led to formation of dissolution zone, transitional zone and precipitation zone from the surficial recharging side to the downdip side. During the deep-buried period, the underlying organic-rich coals and mudstones can produce some CO_2 and organic acids, that transported to the overlying sandstones to dissolve minerals including feldspar grains. There are also CO_2 and organic acids from the Palaeogene source rocks and transported to reservoirs of Permian by faulting systems. The reservoirs of type1 burial-thermal histories are featured by extensive dissolution and weak precipitation after two times of meteoric freshwater flushing, the sandstones of type2 are featured by extensive dissolution of feldspars, moderate precipitation of clays after early meteoric freshwater flushing and late burial organic acids and CO_2 leaching, and the sandstones of type3 are featured by extensive dissolution of feldspars and extensive precipitation of clays and quartz cements after experienced only burial dissolution.