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Sandstone reservoir chronological tightening attributed to their mineral components and differential burial-diagenetic evolution-A case study of the He 8 Group, Upper Paleozoic from the eastern Ordos Basin*

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Sandstone types and petrologic components, their differential burial-diagenetic-hydrocarbon filling-pore evolution and its resulted in chronological tightening and impact on reservoir quality of the He 8 gas-bearing Group, Upper Paleozoic from the eastern Ordos basin were studied, based upon the identification and quantitative statistics of conventional, fluorescent and casting thin sections under microscope, research on petrography of liquid inclusions in thin sections under microscope equipped with fluorescence system, measurement of porosity and permeability, pore throat and sandstone size image, capillary pressure, analysis of scanning electron microscope, cathodoluminescence, homogenization temperature and chemical composition of liquid inclusions using Laser Raman spectrometer, combined by the burial-thermal and hydrocarbon-injection history simulation.

Research result shows that there exist three stages of the hydrocarbon injection in the He 8 sandstone reservoirs. The first hydrocarbon injection (210-175 Ma) with low matured organic matter and limited range dimension occurred before the quartz overgrowth and after chlorite film cementation, which is found on the margin of grains, in the primary pores and dyeing the chlorite films. The second ones (165-100 Ma) with high matured organic matters was the major hydrocarbon emplacement, which occurred before the calcite and after illite cementation and the first dissolution, the oil was widely distributed in the primary and dissolution pores, fissures and fractures. The third ones (90-70 Ma) with high to over matured organic matters, migrating into the sandstone reservoir along fracture and dissolution fissure system, occurred after the calcite cementation and the second dissolution, which dissolved, replaced and covered the second oil. However, hydrocarbon injection entered into the sandstones and emplacement phases show differentiation due to sandstone types and petrologic components and their differential burial-diagenetic-hydrocarbon filling-pore evolution, which resulted in the sandstones becoming tightened chronologically.

The twice hydrocarbon injection (the first and the second ones) was recorded in the high plastic litharenite (with $\geq$15% plastic grains) and the tightening period occurred in 270-210Ma. The high plastic litharenite basically became into reservoir with low porosity and permeability, part of them to tight reservoir after experiencing the compaction in the early diagenetic phase, compaction caused av.22.4% pore loss and average pore loss due to cementation was 5.2%.

The once oil filling (the first hydrocarbon filling) was recorded in the calcareous sandstone (with $\geq$15% carbonate cement) and the sandstone was largely turned into tight reservoir after the calcite cementation, which occurred from the Early to A stage of the Middle diagenetic phase (160-120 Ma). Cementation caused av. 25.0% pore loss and the compaction av.5.2% pore loss in the sandstone.

The twice dissolution and the triple hydrocarbon injection, and multiple diagenesis were recorded in the quartzarenite and sublitharenite. The pore loss was attributed by both compaction (caused av.14.5%

and av.13.2% pore loss for the quartzarenite and sublitharenite, respectively) and cementation (caused av.11.8% and av.10.6% pore loss for the quartzarenite and sublitharenite, respectively). They both turned into reservoirs with low porosity and permeability to tight sandstones during A-B stage of the Middle diagenetic phase (140-110 Ma). Among these two sandstone types, the quartz overgrowth cementation occurred in A-B stage of the Middle diagenetic phase was attributed to the quartzarenite's tightening; while both the quartz overgrowth and the illite cementations formed in A-B stage of the Middle diagenetic phase was the major cements resulted in part of the sublitharenite and the litharenite transformed into tight reservoirs.