Diagenesis of the Heidimiao reservoir in Xinli area

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Abstract. The study of reservoir diagenesis is to reveal the type and characteristics of diagenesis. The general process of reservoir diagenesis research: Firstly, the study of diagenesis products, including systematic observation and analysis of reservoir cores, pays special attention to the changes of reservoir pores in time and space. We can obtain more accurate lithological data, various diagenetic phenomena and pore variation characteristics, and speculate on the diagenesis process that may be experienced. Secondly, according to the diagenetic parameters such as pore fluid temperature and pressure, the diagenesis reaction mechanism is discussed from the perspectives of physical chemistry and thermochemistry. Finally, combined with the stratigraphic, tectonic and sedimentary data of the basin, the reservoir diagenesis model is established to find out the evolution law of the pores.

1. Introduction
According to the diagenesis stage of the target reservoir in the study area, which is divided by organic diagenesis and inorganic diagenetic evolution, it is divided into two stages of the early diagenesis, A and B, and the secondary diagenetic stage A and B, and the diagenetic stage. It must correspond to a certain diagenetic stage. Summarizing the distribution stage of oil and gas formation in China, the A-phase of the Zhongchengyan is the distribution stage of the main oil layer, and the B-late diagenetic stage of the Zhongchengyan is the main distribution stage of the gas layer. The diagenesis stage in China is mainly based on the following indicators: (1) authigenic mineral distribution and formation sequence; (2) clay mineral composition and transformation of illite/montmorillonite mixed clay minerals; (3) rock structure, structural characteristics and pores Type; (4) organic matter maturity; (5) paleotemperature, including fluid inclusion homogenization temperature, authigenic mineral formation temperature, and the like. The whole of the Nen 3 and Nen 4 sections of the study area are in the B stage of the early diagenesis.

The diagenesis of reservoirs in the study area is weak. The main diagenetic types include compaction, cementation and authigenic mineral precipitation. The metasomatism and dissolution and dissolution are relatively weak.

2. Compaction
The compaction strength can be divided into three levels, namely weak compaction, medium compaction, medium strength compaction and strong compaction. In general, the compaction strength
is positively correlated with the burial depth, that is, as the burial depth increases, the compaction effect increases. According to the observation of the flakes, the sandstone in this area is dominated by weak contact with point contact, and the porosity decreases with the increase of depth (figure 1).

![Figure 1 Inter-point and line contact between 334.96 meters and 337.5 meters of fine sandstone particles in Jihe 116 well in Xinli area](image)

3. Cementation
The cementation mainly occurs in the early diagenetic stage. The target layer reservoir in the study area has undergone a relatively strong cementation, such as common carbonate cement, siliceous cement and clay mineral cement.

3.1. Clay minerals
Clay mineral cementation is found in almost all sandstones. Clay minerals are both self-generating and homogenous. They have great differences in composition, structure, and distribution characteristics. Self-generated clays have a great influence on reservoir physical properties, and their occurrence can be divided into three types, including Pore-filled, void-bridged, and pore-filled, filling methods often cause varying degrees of damage to rock reservoir performance. The clay minerals developed in sandstone depend on the composition of the original minerals in the sandstone, as well as the composition, temperature, and concentration of H+ in the pore solution. The clay minerals in the study area are more developed with smectite, followed by kaolinite.

3.1.1. smectite
Smectite is one of the main authigenic minerals in the reservoir of this area (figure 2), and it is also a high content of clay minerals with a relative content of 50% to 92% and an average content of 73.3%. There are a variety of conditions, including pore liners and pore-filled smectites, with pore liners. The appearance of smectite in this area is an early diagenetic event. Shortly after the sandstone deposition, a large amount of smectite precipitates and grows on the surface of the debris particles in the form of a film, which can reduce the pore diameter of the rock by 10/10 to 1/5, and reduce the pore volume of the sandstone by 10 to 20%. The smectite liner can deteriorate the surface properties of the particles and greatly reduce the permeability. Under scanning electron microscopy, the smectite liner is a sheet-like aggregate that grows toward the center of the pore, and the pore-filled smectite is a better leaf-like crystal.
3.1.2 Kaolinite

The kaolinite monomer is a pseudo-hexagonal wafer, and the aggregate is distributed between the particles in the form of a book (figure 3), and is developed in both the early diagenetic and the diagenetic stages. According to X-ray diffraction analysis of clay minerals, kaolinite in Xinli area accounts for 5% to 46% of the total amount of clay minerals, with an average of 22.3%. It is distributed in well areas with shallow depth.

3.2. Carbonate cement

The formation of carbonate rock cement is affected by many factors. Its chemical structure affects the solubility of carbonates, which affects the cementation. The inclusion of a certain amount of carbonate in the pore water is a prerequisite for the formation of carbonate cement. The carbonate cement in the study area mainly consists of calcite and siderite, both of which are formed in the early stage of diagenesis. The carbonate rocks formed in the deep burial stage and the late diagenetic stage are mainly iron calcite and iron dolomite, and the grains are often large, mostly powder-coarse crystals, which have not been seen in the microflakes. At present, the calcite found under scanning electron microscopy is mainly microcrystalline particles, and the siderite is distributed in the form of dispersed crystallites on the surface of smectite. It is therefore the product of the early diagenetic stage. The carbonate rock cement blocks the pores and coarsens the particle size, making the well-classified
sandstone a low-porosity, low-permeability sandstone (figure 4).

4. Accountability
The metasomatism is carried out in a solution film between two particles, and the dissolved substance is carried out through the film, and the metamaterial is precipitated by the film to replace the dissolved substance, and as a result, the original pores may be filled or may be caused. Secondary pores. The metasomatism is not developed in the study area. It can be seen that the clay minerals formed in the early diagenetic stage account for clastic feldspar and cuttings (figure 5).

5. Dissolution
In the study area, the dissolution of feldspar and cuttings is more common, mainly forming intergranular dissolved pores and intragranular dissolved pores. The dissolved pores in the feldspar grains often eroded along the cleavage. The erosion of cuttings is characterized by irregular edges and harbors. In sandstones in which the particles are in close contact, elongated pores and extra-large pores are visible between the localized particles, indicating the dissolution of the crumb particles and the cement together. In the reservoir of the study area, a small amount of feldspar and cuttings are completely dissolved to form a mold hole (figure 6-8).
Jihe 114 well 318.13 meters
Jihe 116 well 325.22 meters

Figure 6 Internal pores in the sandstone reservoir of the Nen 3 member of Xinli area

Figure 7 Well Jihe 116 Well 334.96 m, 338.78 m sandstone reservoir granules

Figure 8 Wells of Jihei 116 Wells of 344.43 meters and 341.69 meters of sandstone reservoirs

In summary, according to the available data, the Nen 4 and Nen 3 reservoirs in the Xinli area are in the B-stage diagenetic stage of the Early Diagenesis. Through the above series of diagenesis, the reservoir pores are mainly composed of mixed pores of primary pores, feldspars, cuttings, partial interstitials and carbonate dissolution pores and micropores; the pore throat combination is mesoporous-high pore. The combination of finer throat type is mainly composed of coarser throat. The fine throat and fine throat restrict most of the pore space, resulting in low mercury removal efficiency and large volume.

6. Conclusion
The diagenetic evolution stage of the sandstones in the Nen 3 and Nen 4 layers of the study area is in the B stage of the early diagenesis. The main diagenetic types are compaction, cementation and
authigenic mineral precipitation. The metasomatism, dissolution and dissolution are relatively weak. The reservoir has undergone a relatively strong cementation, common carbonate cement, siliceous cement and clay mineral cement. The minerals that have been dissolved mainly include aluminosilicate minerals such as feldspar and cuttings, and carbonate cements.

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