

# Evolution of diagenesis fluid and geochemical characteristics of ultra-deep tight gas reservoir--a case of Cretaceous Bashijiqike in Kuqa depression of the Tarim basin, China

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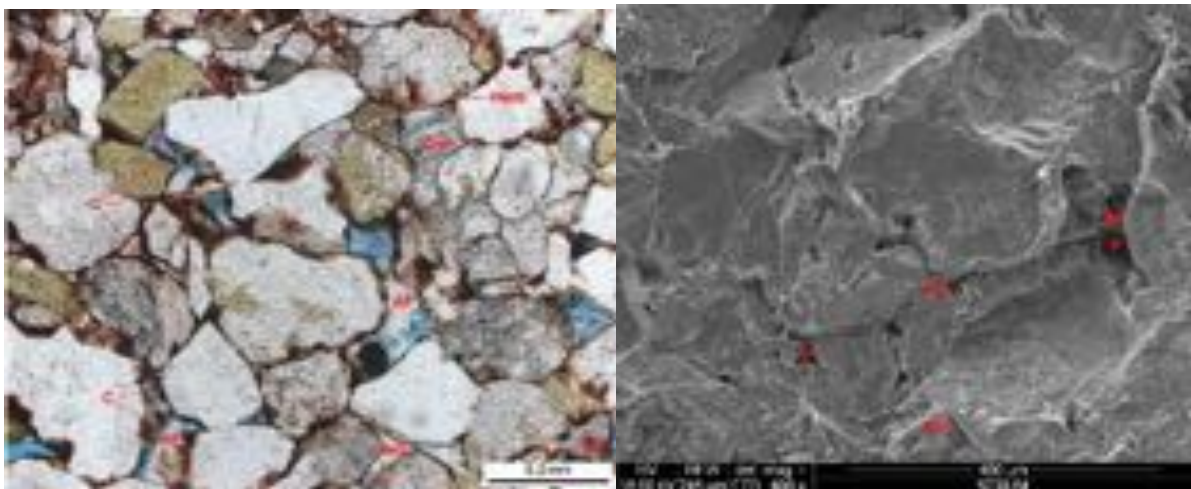
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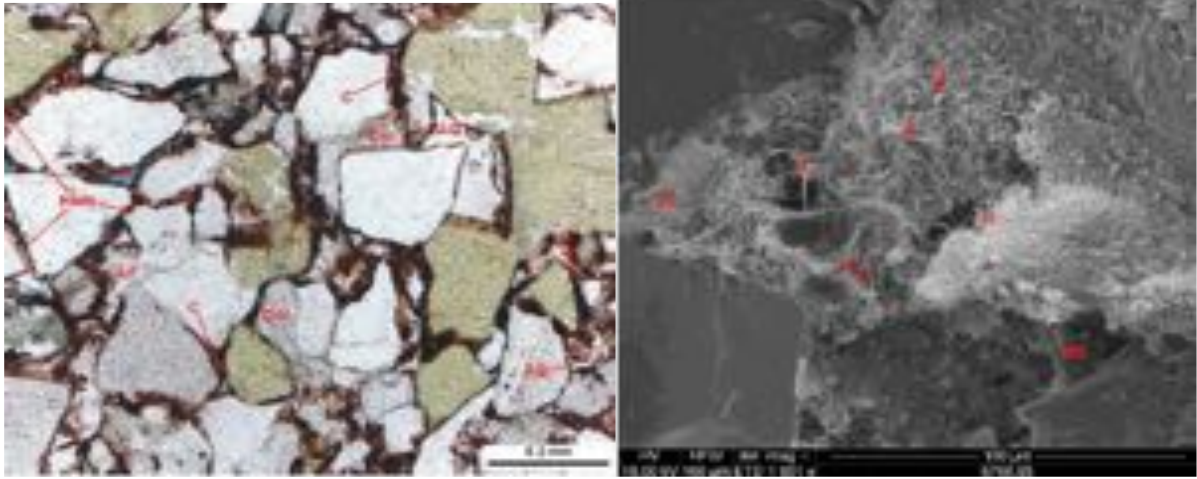
**Abstract:** The ultra-deep reservoir in Kuqa foreland thrust belt with properties of ultra-low porosity, ultra-low—low permeability and high yield test is very important target for gas exploration and development at present. To elucidate the diagenetic fluid types and geochemical characteristics of the Cretaceous Bashijiqike reservoir, this paper is based on the analysis of electron microprobe composition, inclusions homogenization temperature, X-ray diffraction, scanning electron microscope, confocal laser scanning microscope, casting thin sections, salinity and vapor composition, laser carbon and oxygen isotope of diagenetic mineral, and regional geological background. Results indicated that the crystalline dolomite cement has low concentration of Sr, high concentration of Mn and higher carbon isotope, showing the crystalline dolomite is affected by meteoric fresh water, associated with the tectonic uplift of late Cretaceous. Little changed  $\delta^{13}\text{C}$  and negative deviated  $\delta^{18}\text{O}$  with increased diagenesis and combining with the differentiation of the concentration of Fe and Mn, the diagenetic fluid of the vein dolomite cement is homologous with the diagenetic fluid of the crystalline dolomite cement, temperature and depth are the dominant factors of differential precipitation between these two carbonate cements. Anhydrite cements have high concentration of Na, extremely low concentration of Fe and Mn content. Based on these dates, anhydrite cements can be thought to be related to the alkaline fluid overlying gypsum-salt layer produced by dehydration. The barite vein has abnormally high concentration of Sr, ultra-high homogenization temperature and high-density gas hydrocarbon inclusions, which is speculated to be the forward fluid by intrusion of late natural gas. Coexistence of methane inclusions with  $\text{CO}_2$  gas proves existence of acid water during the accumulation of natural gas in the late stages. Therefore, the alkaline environment and associated diagenesis between the meteoric fresh water in epigenesis and carbonic acid in the late diagenesis have dominated the process of diagenesis and reservoir, the secondary porosity and fracture zone formed by gas accumulation is a favorable play for the exploration of ultra-deep reservoirs. Clay mineral content is 5-12% composed by illite and illite-montmorillonite mixed-layer mainly and chlorite secondly. The clay minerals are generated by succession sedimentary

water precipitation in early stage of diagenesis and feldspathic dissolution in middle and late stage of diagenesis (Fig.1) . The early sedimentary clay mineral in the sandstone are mainly enriched in the edge of the delat front or near the top and bottom of the water channel ,and its membrane can effectively inhibit overgrowth of quartz and feldspathic in the ultra-deep reservoir in early and middle stage of diagenesis and preserve matrix pores. The clay matrix of different stage can provide mineral intercrystal micropores with porosity of 1-4% and the intercrystal micropore is one of the main gas reservoir spaces (Fig.2, Fig.3) . Clay minerals are the main controlling factor for reducing reservoir permeability. The clay mineral content of 6-9%(especially illite and illite-montmorillonite mixed-layer ) can reduce the permeability of ultra-deep reservoir by 10-100 times, and result the overall permeability is  $0.01-0.1 \times 10^{-3} \mu\text{m}^2$ . The content of clay mineral and its occurrence characteristics are the key factors for the well preservation of reservoir in the long time(130-23Ma) shallow buried(<3000m) period, the dramatic decrease of matrix permeability in late(23Ma~) deep buried(>3000m) period and reservoir overall densifying( $<0.1 \times 10^{-3} \mu\text{m}^2$ ) . The characteristics and distribution of clay minerals with great geological significance to evaluate the sandstone reservoir properties and to predict the distribution of favorable reservoirs for ultra-deep gas.

**Key words:** Tarim Basin, Kuqa Depression, Cretaceous, Ultra-deep Reservoir, Diagenetic fluids, Geochemical characteristics.



Well1, 6739.48m, clay content 8.2%, mainly composed of sedimentary formation and film., AQ: Authigenic quartz, KF: Potassium feldspar, AF: Authigenic feldspar, I/S: Illishi montmorillonite mixing layer, C: clay, P: pore, left: casting thin sections, right: Scanning electron microscopy



Well2, 6768.65m, clay content 8.5%, based on sedimentary formation, film and filling,AQ: Authigenic quartz, KF: Potassium feldspar, AF: Authigenic feldspar, DC: clay, I/S: Illishi montmorillonite mixing layer, P: pore, left: casting thin sections, right: Scanning electron microscopy

Fig.1 Micrograph of clay minerals in reservoir of Bashijiqike reservoir In the ultra-deep Cretaceous

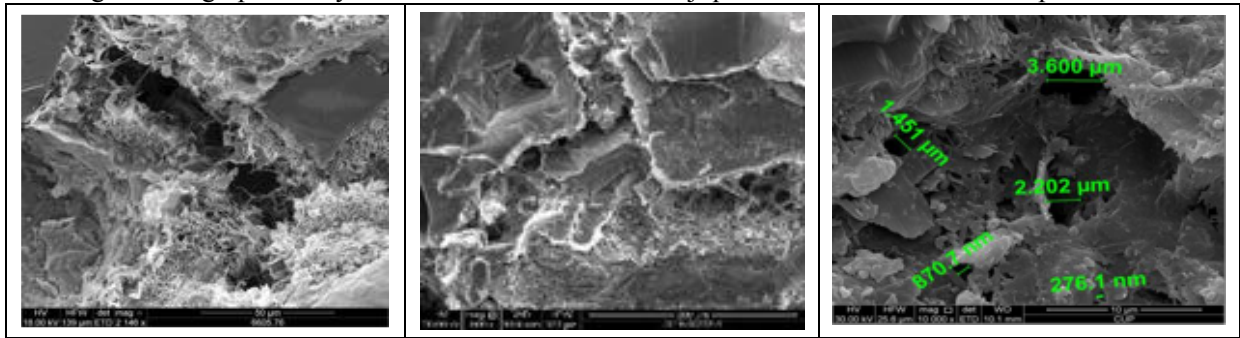


Fig.2 Pore throat blocked with clay minerals and micron pore throat feature of Bashijiqike reservoir In the ultra-deep Cretaceous

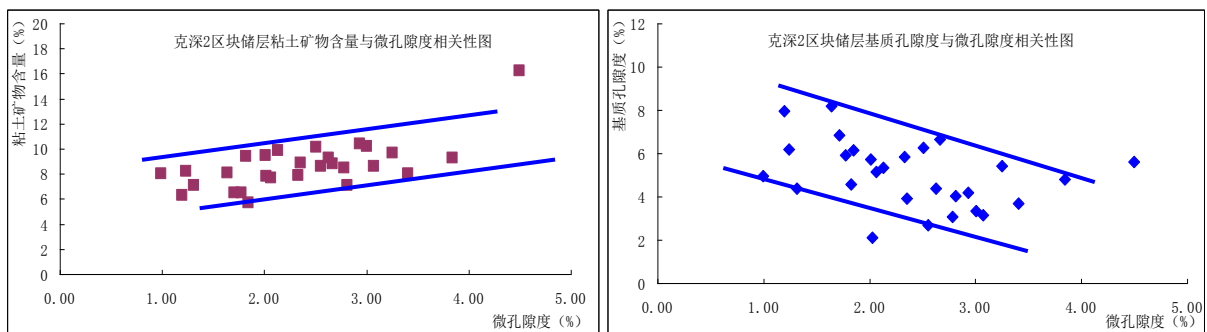


Fig. 3 Correlation diagram of the content of clay minerals and microporosity in the pashkiki formation of the ultra-deep Cretaceous reservoir.

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