Geological Conditions of CO_2 Storage in Songliao Basin，China

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The Songliao basin situated in the Northeast China is one of the largest continental Cretaceous basin in Asia, and underwent three different evolution stages from Mesozoic to Cenozoic. The basinal main subsidence stage of depression is the major developing term of source bed, reservoir and cap rocks in Cretaceous. The rock facies of reservoir consist of mainly sandstones of delta facies and glutenite of alluvial fan and fluvial facies in Nenjiang, Yaojia and Qingshankou formations. The cap rocks in the Songliao Basin are mainly the mudstone at the lower part of Nenjiang formation, of Qingshankou formation and in the middle of Yaojia formation. The traps have different types, including mainly of the anticlinal one, the fault-anticlinal one and the fault one. The fault- anticlinal traps are dominant in the basin.

The shallow horizons buried at the depth of 800m～1700m which are suitable for storage of CO_2 are corresponding to that of main reserviors and caps. The lithology of reservoirs are mainly feldspathic lithic sandstones and lithic arkoses, having the porosity of 20％～25％, permeability of 50～100 MD. The mudstones, including the black ones and oil shales in the member 1 and 2 of Nenjiang formation and in the member 1 of Qingshankou formation, are riched in organic matter and the most important regional caps in the basin. The black mudstone and oil shales in the member 1 and 2 of Nenjiang Formation have the thickness of 200～300m，the depth of 700～1200m. The ones in the member 1 of Qingshankou formation has the thickness of 100～400m，the depth of 1000～1600m. Both of them have the permeability range of 50～100MD. The two types of caps are thick and have a stable wide distribution and pretty beneficial to storage of CO_2.

The chemical compositions of oilfield water in main reservoirs have a transition zone corresponding to the regional cap rock's distribution vertically, which formed different hydrodynamic systems. Total mineralization values of field waters have a range from 4500-5500mg/L to 6000-7000mg/L. The strata from Quantou formation to Nenjiang formation buried above the depth of 1500m can be divided into 5 storage units of CO_2 based on the assemblage of reserviors and cap rocks in the basin. The storage unit of CO_2 is defined as the geological bodies which can store CO_2, and include not only the traps, but also the salt water zone.

At the end of MingShui stage in late Cretaceous and Yi'an stage in Paleogene, the basin inversion took place caused by intensive neotectonic compression and is suggested to be related to the development history of the basin filling. Reversal faults are always distributed along the early synsedimentary faults in deep zone which are weak in dynamic and can be later extended into the shallow horizones under the process of neotectonic, forming the thrust faults, reversal anticline, faulted noses and small faults. The neotectonic movements create not only the anticline trap, fault- anticlin trap which are favorable to the storage of CO_2 on one hand, but also the faults which increase the risk for the storage of CO_2 on the other hand.

The seismic profiles show that the effects of neotectonic movements in Songliao basin are widespread and also limited upwords in the strata, most of the faults are not crossing through the reflectance surface of T_{04} at lower Nenjiang formation. The T_{04} surface is corresponding to the oil shales at the lower Nenjiang formation, which are the regional caprocks and has a plastic property of reducing the fault displacement and then causing the fault ending in them. It is suggested that the storage units of CO_2 in Upper Cretaceous in Songliao basin have a good tectonic stability.

The risk of storage of CO_2 in Songliao basin has been evaluated based on the development of faults and the influence of neotectonic movements. It is suggested that the anticline trap is the best choice for the buried storage of CO_2 because of the lowest influence of neotectonic movements. The closure property of fault-anticline traps is determined by the relation between fault displacement and thickness of caprocks. If the thickness of caprock is bigger than fault displacement, the closure property of fault-anticline traps will not be damaged totally and decrease the risk of the buried storage of CO_2, vice versa.

So the anticlinal trap has the lowest risk, and then the fault- anticlinal trap, the fault trap has the relatively high risk in Songliao basin.