Carbon Capture and Sequestration (CCS) is potentially an effective option to reduce CO$_2$ emissions. Guangdong Province is one of largest CO$_2$ emission area in China, with emissions of $5.67 \times 10^8$ t in 2010, and forecast $7.5 \times 10^8$ t in 2015. The previous research indicated that the storage capacity is limited onshore Guangdong (GD). In addition the dense population and heavy land use onshore make onshore CO$_2$ storage less attractive. However the Pearl River Mouth Basins (PRMB) offshore GD has very large effective CO$_2$ storage capacity. Preliminary estimates its effective capacity is $\sim$200GT. For offshore CO$_2$ storage the main obstacle is the high engineering cost. So the early opportunity for CO$_2$ sequestration offshore is to utilize depleted oil & gas fields with existing infrastructures and the saline aquifer around to offset the cost and expand the capacity. In the offshore PRMB there are numbers of producing oil & gas fields, among which some are close to depletion. The HZ21-1 oil and gas field, one of closing to depleted field, should be best storage site for GDCCS demonstration project because of its good location, structural traps, reservoirs, aquifers, and infrastructures can be reused. Base on the assessment of geology sequestration conditions and potential of oil & gas fields in PRMB, the nearly depleted HZ21-1 oil & gas field was studied. Reservoirs, seals, trap and aquifer in HZ21-1 area were finely described and modeled. CO$_2$ injection numerical simulations in models were done, using TOUGH2 program. The results show that most of the injected CO$_2$ will be in the form of supercritical fluid, a small amount of it will be dissolved in saline. Supercritical CO$_2$ will be diffused in horizontal direction, and it will diffuse in vertical direction under the buoyancy effect and accumulate under seals. Breakthrough will occur after accumulation reach to a certain level. 2000Mt CO$_2$ were injected in HZ21-1 site in 20 years. The upper 200m thick seal and 26 meter thick seal in 2900m depth will not be breakthrough by CO$_2$ in 100 years. After the injection stop, supercritical CO$_2$ continue migration, diffusion, dissolution and declining in the site. The dissolved CO$_2$ groundwater has lager density. It will move downward and accumulated at the bottom of the structure and will not leak to the surface, and then the Dissolved archive will formed. Simulation results show that the proportion of CO$_2$ dissolved was affected by the groundwater salinity. Dissolved proportion will be reduced when groundwater salinity increased. Through the study of modeling and simulation, HZ21-1 sequestration site was considered as a good site that has good injection and storage potential. It is able to achieve the objects that injecting 100Mt/a CO$_2$ (continuous injection of 20 years) and not to leakage in 100 years. Research results can provide a reference for CCS demonstration projects in GD.

Key words: numerical simulation, CO$_2$ geological storage, Aquifers, HZ21-1 oil field, Offshore South China