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Experimental study on brine-CO_2-rock interaction in carbonate formations of Tazhong-Uplift, Tarim Basin China

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Abstract: CO_2 storage in saline aquifers is one of the most effective ways of geological carbon sequestration. In order to better understand brine-CO_2-rock interaction in carbonate reservoirs, 4 series of autoclave experiments with the carbonate rock powder samples with injection of super critical CO_2 have been performed. Two core samples were collected from the TC1well at the depth of 4030m (Lianglitage Formation) and 5100m (Qiulitage Formation), and another two samples from corresponding formation and with varing mineral content were collected from the Yijianfang outcrop and Xiaoerbulake outcrop in Tazhong-Uplift, Tarim Basin, China. The experimental conditions simulate the environment of the reservoir around 4000m depth at the Tazhong Uplift with 25Mpa and 120 degree, where the brine water is $CaCl_2$ type with TDS equal to 135g/l. The FESEM,EDS, XRD, ICP-OES analysis have been performed to examine the mineral chemical composition, morphology and water solution change. The results show that, in all cases after the injection of CO_2, with CO_2 dissolution, pH shows a decrease at the beginning days of the experiments and start to rise, becomes stable at the end of the experiment. Where as, with the dissolution of the minerals results in continuous increase in electrical conductivity. The SEM analysis demonstrates the dissolution of the calcite and dolomite resulted in a rough surface structure and the sharp edges of calcite and dolomite are dissolved. Also, it is able to observe the formations of new micropores and formation of secondary minerals such as ankerite. In the fluid analysis, Ca^{2+} is the dominant dissolved cation and originated from calcite and dolomite dissolution. The concentration of Ca^{2+}will first increase sharply and then decreases, whereas concentration of Mg^{2+} will increase slowly, which means calcite dissolution take places faster than dolomite dissolution. Numerical modeling has been applied to validate the experimental observations with corrected reaction rate. These results can be used for numerical calculation of mineral trapping over long period. This study is helpful for implementation of carbon sequestration plan in Tarim Basin, China.