Experimental study of residual CO_2 trapping mechanism for the prediction of CO2-behabior in porous sandstone

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CO_2 Capture and Storage (CCS) in geological formation has been increasingly considered as a promising technology and most straightforward carbon management strategy for fossil-fuel derived CO_2. Now, we are strongly demanded to confirm the safety of CO_2 in reservoir in long term (>1000 years) by various kinds of geophysical monitoring, computer simulations and laboratory tests. It is considered that four CO_2 trapping mechanisms exist in reservoir (Structural & Stratigraphic trapping Residual CO_2 trapping, Solubility trapping and Mineral trapping). In these four trapping mechanisms, residual CO_2 trapping is important as the first steps of CO_2-satabilazation in reservoir. In this study, we tried to reproduce the residual CO_2 trapping in laboratory and measured compressional wave velocity (Vp) and shear wave velocity (Vs) with injecting CO_2 and CO_2-saturated water under in-situ conditions of reservoir (Confining Press:12 MPa,Temp.:40 C). At first, super critical CO_2 were injected to water saturated rock at 10.2 MPa (Drainage). After drainage, we carried out re-injection of water at 10.2-10.3 MPa, to reproduce residual CO_2 trapping (Imbibition). The results of celocities measurement, Vp showed large velocity reduction over 10% in drainage. In imbibition, they increased near 4%. These results indicate that the CO_2 remained in samples as residual trapped CO_2. Vs also showed 1% of Vs increase in drainage. In imbibition, Vs showed small reduction (>1%). It is considered that the changes of Vs are only effected by change of density. We tried to estimate the CO2 saturation (S_{CO2}) from Vs. The results of this estimation, we could obtain the changes of S_{CO2} (S_{ir}=53.7 % and S_{gr} =5.6%). From this estimation, it was made clear that over 10% of injected CO_2 were trapped in pores as residual trapped CO_2. This is smaller value of previous estimations and/or predictions. We need the further examination about this. At last, we estimated the change of CO_2 distribution pattern in pores based on Gassmann model. This estimation indicated the changes of CO_2 distribution pattern from Patch to uniform between drainage and imbibition. This result implied that we have to take in new mechanisms to CO_2 stabilization process.