Visualization and measurement of CO_2 microbubble flooding in heterogeneous sedimentary rock

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We carried out laboratory experiments of CO_2 microbubble and normal bubble flooding in porous sandstone to confirm the difference in dissolution and sweeping effect. During the experiments, we obtained the specimen porosity and monitored fluid saturation process by using CT image analysis. Sarukawa sandstone (diameter: 34.80mm, length: 79.85mm, north central Japan) was used in this study. Porosity of specimen determined by X-ray CT imaging is 30.94%. The specimen has heterogeneous structure. The experiments were conducted under the pressure and temperature conditions that simulate underground environments; pore pressure: 10MPa, temperature: 40 degrees Celsius. The confining pressure selected in this study is 12MPa. The specimen was first saturated with KI aqueous solution (12.5%), and then oil was injected to make oil-water mixed state. Totally, ten steps of flooding were performed for each experiment. For each step, KI aqueous solution and oil were carefully recovered from the syringe pump (back pressure pump). We increased the differential pressure to examine the influence of differential pressure on oil recovery in heterogeneous media. The microbubble and normal bubble flooding tests were carried out until the total fluid injections reach about 3PV (pore volume). Figures a) and b) show the differential CT images when the CO_2 microbubble and normal bubble injections reach 2.95PV and 2.98PV, respectively. It is clear that the CO_2 microbubbles were able to sweep out more than the normal microbubbles. For example, the oil recoveries were identified as 56.04% and 45.12% after 1.0PV injection of CO_2 in the specimen. The case of microbubbles is about 10.92 % point higher than the case of normal bubble.

Keywords: X-ray CT, CO2 microbubble, CO2 normal bubble, heterogeneous rock

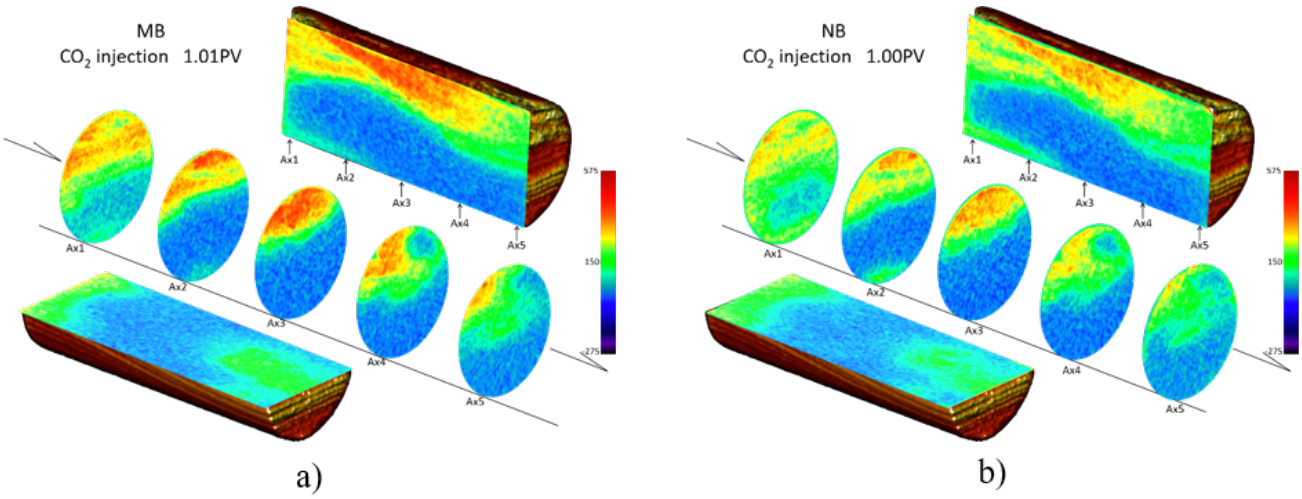

Figure. X-ray CT differential images of CO_2 microbubble and normal bubble flooding in the Sarukawa sandstone a) after 1.01PV(pore volume) injection of CO_2 microbubbles, b) after 1.00PV injection of CO_2 normal bubbles

