Comparison of RTM results of time-lapse imaging in foam-assisted EOR

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Due to the demand of oil remains high in the world, enhanced oil recovery (EOR) plays an important role to optimize the oil production from existing reservoirs. Among the EOR methods, foam-assisted EOR, one of the chemical methods, has drawn attention for its enhancement in sweep efficiency and incremental oil recovery. Although the mechanisms of the foam-assisted EOR have been revealed both in macroscopic and in microscopic ways, methods for monitoring the movement of pore fluids in the reservoir have not been fully established yet. Since seismic waves bring the state variation of the pore fluids where seismic wave propagated, we hypothesized that seismic methods could capture the movement of pore fluids in the reservoir in the practice of the foam-assisted EOR. For testing this hypothesis, we conducted numerical experiments on the time-lapse monitoring of foam-assisted EOR using seismic methods. In the previous studies, our numerical results indicated that we could capture the position of foam and the advancement of injected fluids, i.e. foam, CO2, and water, using simple AVO (Amplitude Versus Offset) analysis, and we would like to locate the advancement of the injected fluids in the subsurface through the application of the reverse time migration (RTM) to time-lapse seismic exploration data. Although our results showed the effectiveness of the seismic exploration method, the effect of the recorded component (vertical and horizontal) on the imaging results has not been revealed yet. In our previous study, we only utilized the vertical component for RTM imaging, i.e. information comes from P-wave reflections were mainly used. It is known that wavelength of S wave is shorter than that of P wave, and therefore the improvement of resolution is expected by including S wave in seismic analysis. As horizontal component of recorded data is mainly derived from S waves, we compare the RTM results of horizontal component and vertical component of recorded data. Results of our numerical experiments show that RTM results using horizontal component show the position of advancement of the injected fluids more accurately than those of vertical component. The signals which cannot be seen in the results of vertical components are observed slightly. In this study, we confirm the difference of RTM visualization caused by the components of recorded data used in RTM, and indicate that integration of analyses of RTM results obtained from two components would help the interpretation of results.

Keywords: foam-assisted EOR, Reverse Time Migration, time lapse, numerical simulation

