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Using oxygen isotopes to quantitatively assess residual CO_2 saturation during the CO_2CRC Otway Stage 2B Extension residual saturation test

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Recent research has shown that the oxygen isotope ratio (δ^{18}O) of reservoir water can change due to isotopic equilibrium exchange with injected CO_2. These changes have been successfully used to assess reservoir saturation with CO_2. We present the first δ^{18}O measurements from a single-well experiment, the CO_2CRC Otway 2B Extension project, used to estimate levels of residual trapping of CO_2. Following the initiation of the drive to residual saturation in the reservoir, reservoir water δ^{18}O decreased, as predicted from the baseline isotope ratios of water and CO_2, over a time span of only a few days. The isotope shift in the near-wellbore reservoir water is the result of isotope equilibrium exchange between residual CO_2 and water. For the region further away from the well, the isotopic shift in the reservoir water can also be explained by isotopic exchange with mobile CO_2 from ahead of the region driven to residual, or continuous isotopic exchange between water and residual CO_2 during its back-production, complicating the interpretation of the change in reservoir water δ^{18}O in terms of residual saturation. A small isotopic distinction of the baseline water and CO_2 δ^{18}O, together with issues encountered during the field experiment procedure, further prevents the estimation of residual CO_2 saturation levels from oxygen isotope changes without significant uncertainty. The consistency of oxygen isotope-based near-wellbore saturation levels and independent estimates based on pulsed neutron logging indicates the potential of using oxygen isotope as an effective inherent tracer for determining residual saturation on a field scale within a few days.