

Thresholds of anomalous pCO₂ in sea water

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In this study, we discuss a method to detect CO₂ leakage in shallow sea at offshore geological storage sites. Even though it is believed that CO₂ leakage is improbable, we have to monitor the sea areas around the storage site in case to be able to find CO₂ leakage as soon as possible should it occur. CO₂ leakage would increase the concentration of CO₂, or partial pressure of CO₂(pCO₂) in sea water, and so if pCO₂ values exceeding the threshold value are obtained in the monitoring, there is suspicion of CO₂ leakage. However, it is challenging how to set the threshold. Two thresholds have been discussed and compared in this study; one is “the seasonal threshold” where constant threshold values are set seasonally, and the other is “the pCO₂-DO threshold” where threshold values depend on the percentage dissolved oxygen (DO) saturation. We analyzed data observed in Osaka Bay, the eastern part of which are prone to be stratified and the western part of which are prone to mixed vertically. Important is to realize that false-positives and false-negatives are inevitable. The smaller threshold values are, the less false-negatives would occur but the more false-positives occur. Therefore, we should compare the frequency of false-negatives of the two methods under the condition that the frequency of false-positives is almost the same. Of the two methods which is the better depends on the area and the season. The seasonal threshold method is the better or not the worse than the pCO₂-DO threshold method except in the stratified area in summer. But in the stratified area in summer, the seasonal threshold is of little use as the leakage detection method while the pCO₂-DO threshold is moderately useful in any season and in any area. In conclusion, the pCO₂-DO threshold is not always the best method to detect CO₂ leakage, but it always functions as the leakage detection method, at least in the case of Osaka Bay.

Keywords: offshore CO₂ storage, pCO₂, leakage