

Marine monitoring methods and strategies at offshore CO₂ storage sites

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Carbon dioxide (CO₂) Capture and Storage (CCS) is expected to play an important role in reducing CO₂ emissions, which is essential for mitigating global warming. CO₂ is believed to be stored safely and stable if storage sites and reservoirs are properly selected and managed. However, monitoring to detect CO₂ leakage is essential. First, it is because the monitoring is believed to help win public acceptance for CCS. Second, it is because the monitoring is mandatory in many countries and regions. In Japan, CO₂ storage under the seabed, that is offshore CO₂ storage, is an important option, so that monitoring methods and strategies in the marine environment should be developed. In this paper, we outline the methods and strategies that we have developed. CO₂ takes the form of bubbles if it leaks out from the seabed of shallow sea. Since CO₂ bubbles are relatively easy to dissolve in seawater, there are two approaches to detect CO₂ leakage; one is to detect CO₂ bubbles in the water column, and the other is to detect increment of dissolved CO₂ in seawater. To detect CO₂ bubbles, we propose to use side-scan sonar (SSS). We have conducted an in situ experiment where CO₂ bubbles were released at the seabed of shallow sea and searched for with SSS towed by a vessel. The experiment has shown the minimum release rate of bubbles and the farthest distance from SSS that SSS can detect. To detect increment of dissolved CO₂ in seawater, we have studied a threshold method to judge the measured pCO₂ (partial pressure of CO₂) to be normal or anomalous. We have proposed a pCO₂-DO covariance method. We emphasize that it is difficult to make a threshold that never makes both false-positives and -negatives. There remains a challenge in the monitoring: where to monitor? Even if a good method is used in the monitoring, CO₂ leakage would never be detected if it occurred outside the monitoring area. Hence, we propose to conduct what is called a deep-focussed monitoring which is the monitoring of reservoirs and overburden before the marine monitoring (which is a shallow-focussed monitoring). To conduct the marine monitoring in the area where CO₂ would leak out, the possibility of the leak detection becomes high.

Keywords: offshore CO₂ storage, marine monitoring, Leak detection