

A fundamental study on monitoring of geological storage of carbon dioxide based on tilt on the surface

Hiroki Yoshida

Abstract

Recently, geological storage of CO₂ has gotten a lot of attention for decreasing global warming. In this technology, monitoring technique is extremely important for confirming the state of storage and detecting the leakage of CO₂. For this purpose, a technique for evaluating fluid volume changes at depth from tilt data measured on the surface has been proposed. In previous studies, this technique evaluated them with high accuracy only at small depths. However, at great depths where CO₂ is stored, tilt data on the surface are so small that it may be difficult to evaluate fluid volume changes. Therefore, this study aims to know whether the previous method can evaluate fluid volume changes at a depth of up to 2000m.

The results of forward analysis, in which the surface tilt was evaluated from a given fluid volume increase at depth, have shown that as the depth of the region of fluid volume increase becomes greater, the tilts on surface become smaller, and at the same time, the surface area where the tilts change expands.

The results of inverse analysis, in which the fluid volume increase was evaluated from the surface tilt, have shown that as the depth of the region of fluid volume increase becomes greater, the error in the volume changes becomes greater, and that if fewer tilt data are used for inverse analysis, the error also increases. Moreover, the size of the region that is assumed to estimate the volume change greatly affects the error.

In addition, I performed the inverse analysis by adding noise to the tilt data. The results have shown that as the amount of noise becomes larger, as a larger region is assumed to the fluid volume change and as the fewer tilt data are used for inverse analysis, the contour plot of fluid volume increase is more distorted and more underestimated.

For future work, it is necessary to develop a method for evaluating fluid volume change that is more complicatedly distributed and to investigate the best position of tiltmeters in order that this technique will be used in the field.