Development of massively parallelized simulation technique for CO_2 geologic storage

Project Representative

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Abstract

Uncertainties due to gridding effects in terms of grid shape and resolution are investigated and demonstrated for the numerical simulation of CO_2 geologic sequestration. The pilot test will conduct a large-volume CO_2 injection in a saline formation in California' s Central Valley, and preliminary simulations using a coarse rectangular grid have already been performed to predict CO_2 plume migration and trapping mechanisms. For this study, we generated a high-resolution model with Voronoi discretization in which the lithologies (sand/shale distribution) in the original geological model under a resolution of 1000 layers were fully represented. To solve the high-resolution model efficiently a parallelized version of TOUGH2, TOUGH2-MP/ECO2N was used on the Earth Simulator. Our results indicate that coarse grids cannot fully represent the original geological model, but also considerably underestimate gravity override, and thus the maximum lateral extent of CO_2 plumes is also underestimated to a few tens of percent for our cases.

Keywords:　large-scale simulation, CCS, CO_2, global warming, groundwater

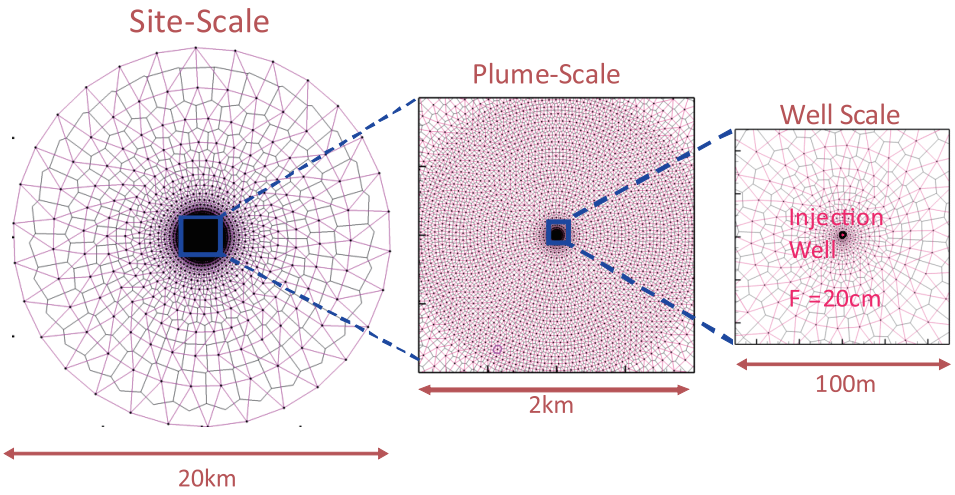

Figure 1　Multi-scale grid model used in this study. The mesh covers from 20km site-scale down to 20cm well scale around the injection well. Voronoi polygons in black lines and connections among them in pink lines. Dots are nodal points of the gridblocks.

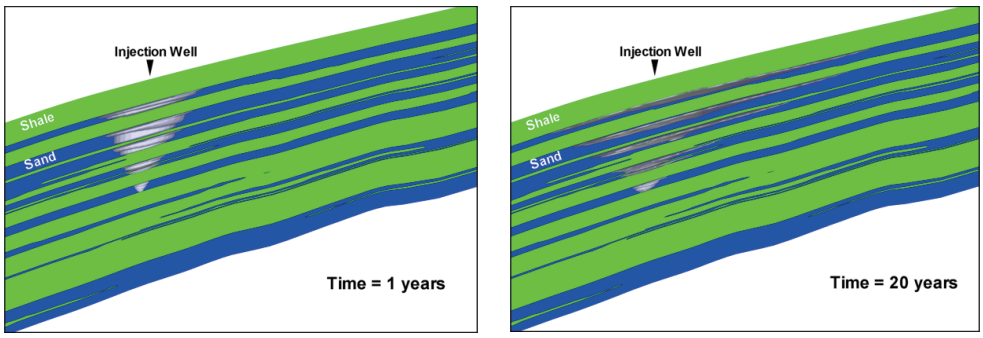

Figure 2　Time evolution of CO_2 plumes (gray colored) spreading from the injection well on a vertical cross-section. Due to low permeability in the shale layers, CO_2 can migrate only in the sand layers. The fine resolution in the vertical direction helps well represent irregular nature of the alternating sand/shale formations without over-simplifications.