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**Massively Parallel Simulation of CO<sub>2</sub> Geologic Storage -An Approach for Investigating Impact on Basin-Scale Groundwater Flow System**

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Large-scale storage of carbon dioxide in saline aquifers may cause considerable pressure perturbation and brine migration in deep rock formations, which may have a significant influence on the regional groundwater system. With the help of parallel computing techniques, we conducted a comprehensive, large-scale numerical simulation of CO<sub>2</sub> geologic storage that predicts not only CO<sub>2</sub> migration, but also its impact on regional groundwater flow. As a case study, a hypothetical industrial-scale CO<sub>2</sub> injection in Tokyo Bay, which is surrounded by the most heavily industrialized area in Japan, was considered, and the impact of CO<sub>2</sub> injection on near-surface aquifers was investigated, assuming relatively high seal-layer permeability (higher than 10 microdarcy). A regional hydrogeological model with an area of about 60 km×70 km around Tokyo Bay was discretized into about 10 million gridblocks (Figure.1). To solve the high-resolution model efficiently, we used a parallelized multiphase flow simulator TOUGH2-MP/ECO2N on a world-class high performance supercomputer in Japan, the Earth Simulator. In this simulation, CO<sub>2</sub> was injected into a storage aquifer at about 1 km depth under Tokyo Bay from 10 wells, at a total rate of 10 million tons/year for 100 years (Figure.2). Through the model, we can examine regional groundwater pressure buildup and groundwater migration to the land surface. The results suggest that even if containment of CO<sub>2</sub> plume is ensured, pressure buildup on the order of a few bars can occur in the shallow confined aquifers over extensive regions, including urban inlands.

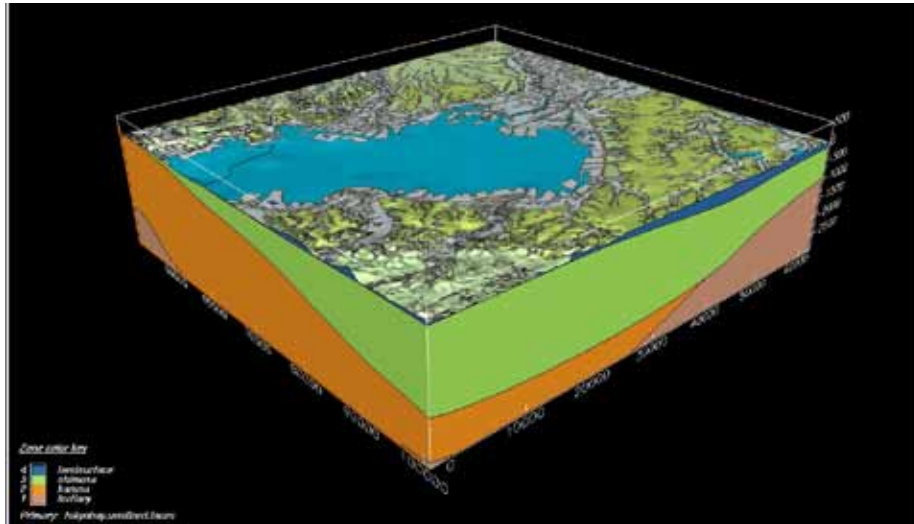


Figure.1 Basin-scale hydrogeological model (60km×70km)

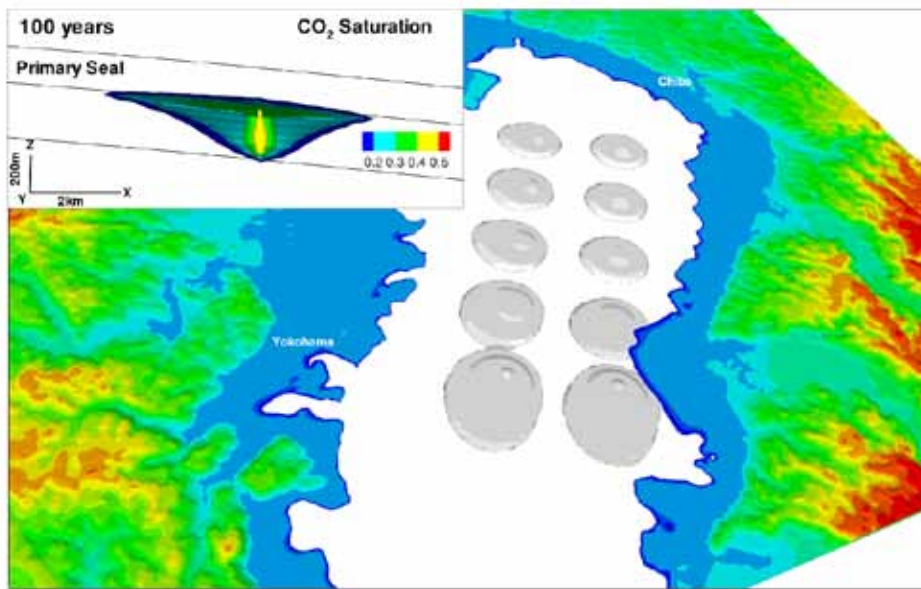


Figure.2 CO<sub>2</sub> plumes spread from 10 injection sites in Tokyo Bay