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Flow path and velocity by 3-D groundwater flow simulation based on detailed facies analysis of Fukushima Daiichi Nuclear Power Station in Japan

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Since 2011, groundwater contaminated by radionuclides from Fukushima Daiichi Nuclear Power Station (FDNPS) in Japan, flows into the adjacent sea. Despite several countermeasures to prevent outflow of contaminated groundwater into the sea, this issue has not been solved. Contaminated groundwater primarily flows through the unconsolidated sand layer of the upper Pliocene (the Dainenji Formation), which the nuclear reactor was built in. However, results of field survey in areas surrounding FDNPS and boring logs analysis, show that the sand layer is not distributed uniformly and has irregular intercalations of several muddy layers. Such results are needed to reveal heterogeneous facies considering flow path and velocity of contaminated groundwater. In this study, 3-D groundwater flow simulation based on detailed facies to reproduce heterogeneity in the formation was carried out using MODFLOW. Groundwater flow was analyzed by transient simulation. Flow path and velocity of groundwater through the sand layer were controlled by non-uniformly distributed muddy layers. Land and sea side impermeable walls which are countermeasures at FDNPS, reduced outflow of groundwater through the unconsolidated sand layer to the sea. Assuming the impermeable walls do not exist on the simulation model, groundwater outflow to the sea is within the harbor. Potential upward groundwater flow appeared under reactor and turbine buildings. Groundwater flows from a lower aquifer to the upper aquifer through the sandy mud layers below these buildings. In the next step, mass transport simulation of contaminated groundwater will be performed based on results of groundwater flow simulation.

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