

Hydrological changes in response to the Tokachi-oki earthquake in 2003, Japan

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Many hydrological responses induced by the M8.0 Tokachi-oki earthquake in 2003 were observed in Hokkaido and distant area from the epicenter.

In Hokkaido, changes in groundwater level or discharge rate at 31 wells and at an undersea coal mine were detected. Twenty-nine of the 31 changes in groundwater levels or discharge rates can be explained as a poroelastic response to earthquake-induced volumetric strain inferred from a fault model determined by dense static GPS observation (Geographical Survey Institute, 2003). In five wells, observed groundwater-level changes and inferred volumetric strain steps induced by the Tokachi-oki earthquake are consistent with groundwater-level changes that are proportional to the inferred volumetric strain steps induced by four large ($M > 7.5$) earthquakes in 1993-1994. Strain sensitivities determined by correlation between inferred coseismic strain steps and groundwater-level changes in three of the five wells are consistent with those inferred from response of groundwater level to the M2 tidal constituent. Long-term oscillations in groundwater level associated with tsunami were also observed in several wells.

Futhermore, groundwater level changes associated with the Tokachi-oki earthquake were detected at 20 of the 42 distant observation wells located about 1,000 - 1,200 km away from the epicenter. Five of the 20 groundwater level changes are consistent with coseismic volumetric strain step inferred from the fault model determined by Geographical Survey Institute (2003) and strain sensitivities inferred from the M2 tidal constituent.