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# Change of permeability caused by 2011 Tohoku earthquake detected from pore pressure monitoring

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We have monitored pore and atmospheric pressures at the Kamioka mine in Gifu Prefecture, central Japan since 2005 to study relationship between groundwater and earthquake. Pore pressure decreased after the 2011 Tohoku earthquake (M9.0) occurred on 11 March 2011, which may be attributed to expansion of the crust west of the epicenter or a permeability increase. To evaluate rock permeability changes, we analyzed the Earth tide response of pore pressure before and after the earthquake. Pore pressure fluctuates associated with the meteorological effects, Earth tides and crustal deformation. We assumed that without the change of aquifer conditions tidal response of pore pressure is constant. We compared the tidal response before and after the event. We extracted amplitude and phase lag of M2 and O1 constituents from pore pressure by tidal analysis program, BAYTAP-G. These amplitudes decreased and phases changed after the earthquake. It was in accord with pore pressure decreases. We estimated the hydraulic diffusivity using the poroelastic theory and diffusion equation. If we assume that the poroelastic coefficient is constant, the hydraulic diffusivity increased from 8.9 to 65.0 $m^2/s$ at the time of the Tohoku earthquake. We also analyzed data before and after the Noto Hanto Earthquake (M6.9) which occurred in the northwestern part of Ishikawa Prefecture, central Japan on 25 March, 2007. The epicentral distance of the Noto Hanto Earthquake from our observation site is 112 km. No hydraulic diffusivity change is detected. The causes of the hydraulic diffusivity change are potentially related to a static and/or dynamic stress change. In order to discuss the difference in hydraulic diffusivity change between the Tohoku and Noto Hanto earthquakes, we analyzed other earthquakes to relate the hydraulic diffusivity changes, and the amount of static and dynamic strain changes.

Keywords: hydraulic diffusivity, pore pressure, Earth tide