

Possible Mechanisms of Coseismic Changes in Groundwater Level – Recent Examples –

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In the last decade many coseismic changes in groundwater levels have been observed at many deep wells in Japan. In several wells, coseismic changes are consistent with earthquake-induced crustal deformation (Koizumi et al., 1999; Akita and Matsumoto, 2001), although many reports were described that the coseismic changes in groundwater level are tens to hundreds of those changes estimated by earthquake-induced volumetric strain and wells' tidal response (Igarashi and Wakita, 1991; Kitagawa and Azuma, 2000; Akita and Matsumoto, 2001; Matsumoto et al., 2003).

In this presentation, it will be showed that both earthquake-induced volumetric strain and ground shaking may contribute the coseismic changes in groundwater level, using groundwater level changes in 12 wells located in Hokkaido after four earthquakes larger than M7.5 (Akita and Matsumoto, 2001).

Next, one example of well's coseismic changes which are not consistent with earthquake-induced volumetric strain and well's tidal response is shown (Matsumoto et al., 2003). In the Haibara well, central Japan, 28 coseismic changes are observed during the period from 1981 to 1997. All of the coseismic groundwater-level changes at the Haibara well are decreases. The best-fitting relationship between the estimated coseismic steps in volumetric strain and the coseismic changes in water level is 291 mm/10⁻⁸ volumetric strain, and these two coseismic changes are poorly correlated and the correlation coefficient is 0.19. Moreover, the tidal response of the well yields a strain sensitivity of 1.6 mm/10⁻⁸, which is less than 1/100 of the sensitivity that would be needed to account for the coseismic changes. The coseismic changes in groundwater level are more closely proportional to estimated ground motion than to coseismic volumetric-strain steps. These results suggesting that earthquake-induced ground shaking is the major cause of the coseismic groundwater-level drops and that the contribution of static strain step due to earthquake is rather small in the Haibara well.