Continuous groundwater level observation at Mizunami, Gifu Prefecture --- Observed coseismic water level changes ---

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In order to investigate the distortion of crustal movement observation by groundwater flow, Tono Research Institute of Earthquake Science have installed a borehole station in May 1998 which consists of two boreholes with depths of 350m and 165m (TGR350 and TGR165; the distance between the each boreholes is 3 m.) at Mizunami, Gifu Prefecture, central Japan (Asai et al., 2001). This observation station located approximately 3km southeast of SN3, SN1 which observed earthquake-related groundwater level change (King et al., 2000; 2001). We equipped with the Ishii-type multi-component borehole instrument which consists of a 3-components horizontal strainmeter, a 2-components tiltmeter, 3-component seismometer at the bottom of TGR350 borehole and pressure transducer groundwater level gauge (resolution is 1mm) at the 34m depth from ground level, and carried out continuous groundwater level observation with 1 hour sampling since late July 1998, and continuous crustal movement observation (strain and tilt) with 1 Hz sampling since January 1999. In TGR165, we equipped with the small-diameter multi-component borehole instrument (horizontal strainmeter of 3 components, inclined strainmeter of 2, vertical strainmeter, tiltmeter of 2, seismometer of 3, geomagnetometer of 4, thermometer) at the bottom of borehole and groundwater level gauge same as using TGR350 at the 36m depth from ground level, and carried out continuous groundwater level observation with same interval as TGR350 since late April 2002 and crustal movement observation with 1 Hz sampling since late March 2000. This area mostly covered with a Tertiary layer of about 90m thick over the granitic basement. Casing of TGR350 (0-120m depth) and TGR165 (0-150m depth) are equipped to avoid the effect of groundwater flow in the Tertiary layer.

We have observed the TGR350 groundwater level changes response to Earth tides, barometric pressure and clearly coseismic changes following earthquakes, January 21, 1999, Nagano-ken chubu Earthquake. (Mj4.7; Distance from TGR350 and TGR165 is 130km), March 16, 1999, Shiga-ken hokubu Eq. (Mj4.9; 120km), September 21, 1999, Wakayama-ken Hokubu Eq. (Mj5.4; 219km), Taiwan Eq. (Mw7.7; 2027km), November 29, 1999, Aichi-ken chubu Eq. (Mj4.7; 37km), June 7, 2000, Ishikawa-ken Seiho-oki Eq. (Mj5.8; 223km), October 6, 2000, Tottori-ken seibu Eq (Mj7.3; 356km), January 6, 2001, Gifu-ken mino tobu Eq (Mj4.6; 13km), September 27, 2001, Aichi-ken seibu Eq. (Mj4.3; 47km), September 26, 2003, Tokachi-oki Eq. (Mj8.0; 928km). These all coseismic response are 'rise' of water level. To date, the largest coseismic water lever rise is 1.2m after October 6, 2000, Tottori-ken seibu Eq. The general feature of coseismic water level changes are that water level rise occurred 2-3 week after earthquake, and the secular change resumes 1-3 month after peak of change. We obtained the dependence (Matsumoto, 1995) upon Magnitude of Earthquake (M) and well-hypocenter distance (D) in kilometer is M=1.81xlog10(D)+1.66. TGR165 changes are in agreement with TGR350 from late April, 2002, and response to September 26, 2003, Tokachi-oki Eq is also.

We will present these observations and comparison of coseismic groundwater level changes and Strain/Tilt changes.