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SCG65-05 Room:423 Time:May 2 10:00-10:15

Motions after rainfall in borehole tiltmeters and the azimuth of crustal stress before and after 2011 Tohoku Earthquake

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Shimada (1987) has revealed that in borehole telemeter generally the tilt motions after rainfall are tilting to a certain azimuth which is named 'rainfall component', and the perpendicular azimuth is named 'rainfall-free (RFF) component'. In the time series of the RFF component, very little motions are seen after rainfall. From the observations of tiltmeters in NIED Kanto-Tokai network, Shimada (1987, 1989) has found that the azimuths of the RFF component are generally coincided with the azimuth of the crustal maximum compressive stress obtained from the experiments of hydrofracturing and the mechanisms of middle or large scale earthquakes. This is interpreted that the azimuth of the strike of the nearby open crack of the borehole is generally coincided with the azimuth of the crustal maximum compressive stress.

In this study, we examine the azimuth of tilt motions after rainfall for Hi-net borehole high-sensitivity accelerometer (tiltmeter) in the periods from April to December in 2010, 2011, and 2012 before and after the 2011 Great Tohoku Earthquake in the region of the border of Ibaraki and Fukushima prefectures, and the time variations of the azimuth of the maximum principal crustal stress.

The left figure shows the azimuth of the RFF component of the seven borehole tiltmeters in this area obtained from the time series from April to December 2010. In IWEH site, the azimuth of the RFF component is almost N-S direction, suggesting in the nearby area of this site the maximum compressive stress was not E-W direction even before the 2011 Great Tohoku Earthquake. Among the sites south of IWEH site, in the sites near IWEH site and coastal sites the RFF components are generally almost NE-SW direction, suggesting in the area the maximum compressive stress does not coincide with E-W direction which is seen widely in NE Japan before the 2011 Great Tohoku Earthquake.

The right figure shows the azimuth of the RFF component of the same seven borehole tiltmeters obtained from the time series from April to December 2011 or 2012. In this period, there occurs many offsets and large drifts after those offsets arose by the induced earthquakes and aftershocks of the 2011 Great Tohoku Earthquake, and it is not so easy to detect the detections of the motions after rainfall and the azimuth of the RFF components comparing with the period in 2010. In HTAH and YBKH sites, there seems very little time variations in the azimuth of the RFF component. Also in IWEH site, the time variation of the azimuth of the RFF component is only 10 degree. In IWWH site, the azimuth of the RFF component changes significantly, and almost N-S direction. In DGOH site also the azimuth of the RFF component changes from the NE-SW direction before the earthquake to the NNE-SSW direction. In THGH sites, there are very large noises in N-S component in 2012, which is probably mechanical faults, and there seems very little time variations in the azimuth in 2011 compared with that in 2010. In JUOH site, very little tile motions are seen after rainfall, suggesting the closing of the crack opened in 2010 because of the time variations of the azimuth of crustal stress.

Estimating from the tilt motions after rainfall before and after the 2011 Great Tohoku Earthquake in the Hi-net sites in the area of the border of Ibaraki and Fukushima prefectures, it is suggesting that the area with the N-S direction maximum compressive stress is exist near the IWEH site even before the earthquake, and that mainly in the area west of IWEH site the maximum compress stress shifts near N-S direction after the earthquake.

Keywords: borehole tiltmeter, tilt motions after rainfall, azimuth of crustal stress, 2011 Great Tohoku Earthquake

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