Observation of Creep on Valley Fault System in Republic of the Philippines by InSAR and leveling survey(Part II)

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Many ground deformations have been occurred by earthquakes and volcanic activities in the Republic of the Philippines. The monitoring of deformation using InSAR, which is capable to observe a wide area at high spatial resolution, as well as GPS measurement and leveling survey, which are capable to measure the point-based but subtle land displacement less than a centimeter, is actively conducted in this country. The West Valley Fault (known also as the Marikina Fault) exhibits fault creep. It is a north-south trending active fault in the Metro Manila district, central Luzon. Buildings and road pavement are damaged by vertical displacement of the ground where the central segment of the fault passes through. Though these events were probably induced by tectonic activity, they may be related to extensive groundwater extraction.

Leveling survey has been carried out on six lines crossing the fault 2 to 4 times every year since 1999 in the area and subsidence phenomenon is found in the eastern area of the fault. According to Kinugasa et al. (2006) (∗1), the average amount of land subsidence was 0.6 to 1.4 cm/year before 2004, while it was 2.0 to 4.2 cm/year after 2004. This indicates that the rate of displacement has been increasing rapidly with time. Meanwhile, Deguchi et al. (2007)(∗2) applied SAR interferometry to the JERS-1/SAR data obtained from 1993 to 1998 and ENVISAT/ASAR data acquired from 2003 to 2005 and reported that it showed good agreement with the results obtained by the leveling survey.

In this study, we performed detailed analysis on the temporal change of surface deformation by applying smoothness-constrained time series analysis using ABIC minimization method to the result of InSAR from ENVISAT data between March 2003 and January 2007. The analysis clearly showed the displacement toward satellite (approximately 1.5 cm/year) and that away from satellite (1.1 cm/year) on the west and east side of the Valley Fault, respectively. In addition, a total of eight phase anomalies that indicate the large-scale ground subsidence were detected. These were considered to be caused mainly by overpumping of groundwater. The largest subsidence was extracted in Valenzuela, north Manila, where the subsidence of 10.6 cm/year was observed. The results of measurement by InSAR using PALSAR data were fairly consistent, which demonstrated the ground subsidence in the same locations as the result using ENVISAT. However, slow displacement occurring along the Valley Fault could not be detected due to the short operation period of ALOS/PALSAR. We intend to determine the distribution of deformaiton around the Valley Fault in detail as more PALSAR data accumulate and become available in the future.

(∗1) Y. Kinugasa, K. Papiona and R. Rimando (2006) : Creep-slip of active faults in Asia, an example from the Valley Fault System in Metro Manila, Eos Trans. AGU, 87(36), West. Pac. Geophys. Meet. Suppl., Abstract T34B-04 INVITED, July, 2006.

(∗2) T. Deguchi, Y. Kinugasa, M. Omura (2007) : Observation of Creep on Valley Fault System in Republic of the Philippines by InSAR and leveling survey, Japan Geoscience Union Meeting 2007.