

Combined use of GPR and surface wave methods for study of the 2008 Wenchuan earthquake ruptures in Dujiangyan, China

Takao Miyata^{1*}, Ayako Hirai¹, Yasuko Kuwata², Jingpeng Hong³, Xiaofang Fu⁴, Liwei Hou⁴

¹Graduate School of Science, Kobe U., ²Graduate School of Engineering, Kobe U., ³RCUSS, Kobe U.,

⁴Sichuan Geological Survey

On 12 May 2008, the Mw7.9 Wenchuan earthquake occurred in the Longmen Shan margin between the eastern Tibetan Plateau and Sichuan basin, China. Along this margin, the northeast-striking Longmen Shan fault zone is known [1]. This earthquake was caused by fault movement on the Longmen Shan fault zone. Many co-seismic surface ruptures appeared along the Beichuan fault and Hanwang fault. On November in 2008 and June in 2009, we carried out ground-penetrating radar (GPR) and surface wave surveys in order to obtain the subsurface structures of the co-seismic ruptures at selected ten sites, under a cooperative research project between Kobe University (Japan) and the Sichuan Geological Survey in Chengdu (China) [2]. We will report here the obtained results from our two surveys in the Dujiangyan scenic area.

We used a GPR SIR-3000 system (GSSI) with 100 MHz antennas[3]. The ranges of the two-way travel time are 150 ns and 250 ns. By using the RADAN6 software, the GPR data were processed by high- and low-pass filters to clear geologic features and to reduce the system noise. We carried out the migration processing for them if necessary. The depth profile was changed from the time profile by the wide-angle measurement. Meanwhile a surface wave test [4] was carried out at two Sites 4 and 5. Using a McSEIS-SXW (OYO), the surface wave is measured by 24 geophones set with 2 m interval along the survey line, catching wave provoked by hammer on the ground surface between geophones. The shear wave velocity of the subsurface soil is evaluated in two dimensions based on the phase difference among waves of the geophones.

The following results were obtained from our two surveys: (1) Anomalous detection of reflected signals was found on the GPR sections at all selected sites in Dujiangyan. (2) Their anomalous detection indicates the existence of the NE-striking blind faults in the northeast and southwest areas of Dujiangyan. (3) These blind faults are strongly supported with the flexure-like structures of S-wave velocity. Therefore, it is considered that the Dujiangyan scenic area was strongly damaged by the blind faults. And we found a combined use of GPR and surface wave methods to be useful in grasping the subsurface fault.

References:[1] Miyata, T., 2009, Proceeding of the KU-CDUT-UGM Joint Symposium on Symbiotic approaches for disaster mitigation, learnt from Kobe, Java-mid and Sichuan earthquakes, Kobe and 10 Feb, 5 p, CD-Rom. [2] Miyata, T., Hong, J.P. and Fu, X.F., 2009, AOGS2009, SE56-A004, CD-Rom. [3] Miyata, T., Hong, J.P., Fu, X.F., 2009, Report of Research Center for Urban Safety and Security, Kobe University, n.13, p.255-260. [4]Kuwata, Y., Saito, S., Takechi, J., Miyata, T., Hong, J.P., Fu, X.F., Hou, L.W., 2009, Memoirs of Construction Engineering Research Institute Foundation, n.51, p.117-130.

Keywords: Combined use of GPR and surface wave methods, surface rupture, 2008 Wenchuan earthquake, Longmen Shan fault zone, Dujiangyan scenic area, Sichuan Basin (China)