Dynamic Analysis of Groundwater Level Anomalies Induced by the 0403 Hualien Earthquake: High Sampling Rate Insights from the Milun Fault Groundwater Observation System

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Abstract

Pore water pressure in porous media is sensitive to volume strain that can be used to detect the static and/or dynamic strain induced by earthquakes. Furthermore, fluid is proved to be an important factor in fault activities. Therefore, observation of pore water pressure in a fault system may help understand the mechanism of fluid-fault interactions. In this study, to perceives the possibilities of co-seismic groundwater level anomaly, analysis was carried out in the Hualien area, which has experienced numerous earthquake events. The Milun Fault is estimated to have a high probability for major earthquakes. An integrated observation system for groundwater variations was thus set in the north segment of Milun Fault. A pressure gauge system with four screen openings and four fiber Bragg grating device with a 200 Hz sampling interval was installed in the Milun well. The data from this system were compared with traditional groundwater level data and seismic data from the MiDAS optical fiber seismic observation system. To determine whether groundwater level changes relate to earthquakes, it is crucial to avoid the vertical stimuli such as barometric pressure and rainfall. The data analysis and comparison showed that the stimuli do not give any significant inferences to the system especially the rainfall. The co-seismic groundwater level changes were detected due to M 7.2 and M 6.5 Hualien Earthquake, in a short time span. The high sampling rate (200 Hz) of the system is capable to record these two co-seismic events with both oscillation and step-changes behavior, whereas the Don-Her well and the Huagangshan well which has lower sampling rate of 1 second and 10 minutes, respectively, are unable.

Keywords: Earthquake hydrology, Groundwater pressure observation, Milun Fault, Groundwater anomaly, Fiber Bragg grating.