Groundwater Level Anomalies in Various Depths Relate to Earthquakes in the Milun Fault Observation System, Hualien

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Abstract

Fluid in the crust is very sensitive to crust strain. Solid deformation leads to groundwater level changes in wells, even if the deformation in the crust is small. Previous studies have documented the presence of groundwater level anomalies related to earthquakes. Fluid is proved to be an important factor in fault activities. In this study, to precieve the possibilities of pre-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 consider other factors such as barometric pressure, sea tide, and rainfall. Preliminary observation data show that a groundwater level anomaly occured on September 4th, 2023. There is no corresponding earthquake event during this period and the anomaly should not come from rainfall recharge due to its inconsistent responses. Furthermore, the seismic data from MiDAS system shows a signal of high strain rate during the same duration. Several earthquake events occurred after the anomaly period might be one of the possibility for the triggering. Are the step changes in groundwater level a signal of earthquake precursor or relative to fault activity? Further investigations are required.

Keywords: Earthquake hydrology, Groundwater pressure observation, Groundwater anomaly, Milun Fault, Seismic strain rate