

Anomalous fluid emission at the Taiwan Chelungpu Fault Borehole associated with the 2013 M6.2 Nantou earthquake

C.C. FU^{1*}, C.W. LAI², T.F. YANG², K.F. MA³,
AND L.C. LEE¹

¹ Institute of Earth Sciences, Academia Sinica, Taiwan
(*correspondence: ccfu@earth.sinica.edu.tw)

² Department of Geosciences, National Taiwan University,
Taiwan

³ Department of Earth Sciences & Institute of Geophysics,
National Central University, Taiwan

Change in groundwater geochemistry has been observed before earthquakes since the 1980s in Taiwan and is proposed as a precursor signal. However, the biweekly/monthly sampling interval were commonly performed, some short-term precursory anomalies may not be caught due to the low sampling frequency. We designed an automatic sampling apparatus for the retrieval and temporal analysis of water geochemistry. The device was composed of the syringes connected to glass bottles with the septum for collecting fluids each day, which was installed at the Chelungpu Fault Drilling Project (TCDP) drilling well in central Taiwan for observing the discharge of fluids. The stable isotope ratios for oxygen and hydrogen anomalies of $\sim +0.6\text{‰}$ and $+2.0\text{‰}$, respectively, relative to the local background measured in groundwater were observed as the potential seismic precursor, one month before the Nantou earthquake (M6.2) in central Taiwan. The findings can be explained by different mixing ratios between groundwater variably affected through water-rock interaction, due to seismically induced changes of permeability or the opening of preexisting micro-fractures, which suggest that related to volumetric strain changes of surrounding formation.

We infer that similar processes may be active at some suitable sites which provide the channel for fluids originated from deep crust to migrate upward to the surface, and that geochemical anomaly in groundwater may be useful for future researching on the earthquake precursor.