Hydrochemical Changes of Spring Waters in Taiwan: Implications for Evaluating Monitoring Sites of Earthquake Precursory

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Earthquake is the most destroyed and unpredictable hazards in nature. Therefore, detecting useful short-term precursors of earthquakes have long been an aim of geoscientists. A destructive Chi-Chi earthquake with magnitude $M_L = 7.3$ occurred in west-central Taiwan, causing a total of about 80-90 km in length of surface ruptures along the Chelungpu fault, and the death of about 2,400, injured another 10,000 and destroyed more than 100,000 buildings. After the Chi-Chi earthquake, a large-scale research program to monitor active faults and identify earthquake precursors was jointly initiated by the Central Geological Survey, MOEA-ROC and the Institute of Geosciences, National Taiwan University. In one subprogram, weekly measurements of cation and anion concentrations are made in both hot and artesian springs and groundwater in Taiwan to establish background concentrations and to identify earthquake-related anomalies. To evaluate the potentially monitoring sites and useful ions for earthquake precursors, ten subsurface water bodies in western, northern and northeastern Taiwan were chosen in different tectonic domains. They include deeper circulation of hot springs and shallower artesian spring and groundwater. All of the hot springs show the chemical anomalies which correlated to the earthquake events during the monitoring periods. However, the groundwater didn't respond any events. These results indicate that factors controlling the chemical anomalies as precursors for an earthquake in the waters are the kinds, depth, size of reservoir and ion species

of subsurface water body. Hot springs from the deeper reservoirs are superior to the artesian spring and groundwater from the shallower ones. The artesian spring from the smaller subsurface water body is better than the groundwater from larger reservoirs. Meanwhile, the anions, especially for the chloride are better than the cations as geochemical precursors for earthquake monitoring.