

The hydrogeochemical characteristics of hot springs in Tatun Volcanic Group, Taiwan—concluded from the volatiles and multi-isotopes' observation and the 3-years' geochemical monitoring

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The Tatun Volcanic Group (TVG), wherein the fumaroles and acid hot springs are common phenomena, located in northern Taiwan and on the western end of the Ruykyu subduction system. Despite of the admirable scene and hot spring resources made great scenic spots, it is essential to understand the potential of volcanic eruption in perspective of hazard prevention. Volatiles, such as H₂O, CO₂, halogen and Sulfur species, part of them made the hot springs acidic and were indicative of the underlying magmatic activities directly. However, the hot spring water chemistry were obscured by other hydrogeological factors, therefore, a geochemical clarification was necessary to identify the effective indicators of magmatic activities.

The TVG hot springs reside in both aquifers of volcanic strata and sedimentary strata, which provide distinct elements' sources through water-rock interaction and were distinguished by Sr isotope ratios in our observation. Three types of hydrothermal reservoirs were distinguishing: 1. The primary hydrothermal system (PHS), where the aquifer received direct magmatic gases and were characterized with abundant chlorine and boron. 2. The secondary hydrothermal system (SHS), where the water received acidic gases distilled from PHS, were of SO₄ dominant and low in chlorine and boron. 3. Neutral water aquifers which were probably heated conductively. We also conducted 3-year geochemical monitoring on nine sites covered all the types of hot springs to infer the relative resident time in reservoirs and the water mixing conditions. We found that the B/Cl ratios were quite consistency and indicative of magmatic sources, and the ΣRFE (sum of major rock forming elements) were indicative of degree of weathering. We concluded that the most effective monitoring includes those common on-site measured parameters, anions, B and B/Cl ratios, on those sites which either in PHS and SHS with shorter resident time in TVG. While a consideration on full spatial distribution of monitoring sites were also necessary.

