



Identification of multiple gas components in SW Taiwan and its application for earthquake surveillance

T. F. Yang (1), C. C. Fu (1), V. Walia (1), C-H. Chen (1), T. K. Liu (1), L. L. Chyi (2), S. R. Song (1), C. Y. Lee (1) and M. Lee (3)

(1) Institute of Geosciences, National Taiwan University, (2) Department of Geology, University of Akron, (3) Central Geological Survey, MOEA, Taiwan (tyyang@ntu.edu.tw / Fax: +886-2-2363-6095 / Phone: +886-2-3366-5874)

Many hot springs and mud volcanoes are distributed along the tectonic sutures in SW Taiwan. Representative gas samples have been collected weekly, utilizing pre-vacuumed low permeability glass bottles, since late 1999. Bubbling gases from hot springs in this area usually are CO₂-dominated with minor CH₄ and N₂ contents. In contrast, mud volcanoes generally exhibit CH₄-dominated gas composition with low helium isotopic ratios ($^3\text{He}/^4\text{He} < 0.2 \text{ Ra}$; Ra is air ratio), which are typical crustal signature in origin. Interestingly, gases collected from mud-lake in Chunglun (CL) show anomalous high helium isotopic ratios ($^3\text{He}/^4\text{He} = 5.2 \sim 6.6 \text{ Ra}$). It indicates that significant mantle-derived gas source may exist underneath CL area.

Compiled the available data, at least four gas components can be identified in this area: (1) mantled-derived CO₂: high helium isotopic ratios ($\sim 7 \text{ Ra}$), low CO₂/ ^3He ratios ($1 \sim 2 \times 10^9$), and high helium contents ($> 50 \text{ ppm}$); (2) crustal CO₂: low helium isotopic ratios ($< 0.2 \text{ Ra}$), high CO₂/ ^3He ratios ($10^{11} \sim 10^{13}$); (3) crustal CH₄: low helium isotopic ratios ($< 0.2 \text{ Ra}$), and high helium contents ($> 50 \text{ ppm}$); (4) dissolved air in saturated groundwater: $^3\text{He}/^4\text{He} \equiv 1 \text{ Ra}$, and very low helium contents ($< 1 \text{ ppm}$). Most gas compositions of samples collected from this area can be well explained by mixing of above components with different proportions.

Except for samples from Chunglun (CL) and Kuangtzeling (KZL) areas, CH₄-dominated samples usually show relatively constant gas compositions. It indicates that they were mainly originated from crustal CH₄ reservoir, and were not disturbed by other components even big earthquake events occurred. In contrast, bubbling gases

from CL and KZL hot springs have larger variations and indicate that they were mixed from different gas components. CL hot spring gases, especially, show extreme variations and clearly associated with earthquake events during last two years. It suggests that natural gases originated from multiple sources in suitable tectonic environment, the variations of gas compositions may be sensitive to earthquake events. CL area, hence, has been considered as one of the best locations in SW Taiwan for monitoring gas variations related to earthquakes. An automatic continuous gas surveillance station equipped with quadruple mass spectrometer (QMS) gas analyzer and radon detector has been just setup for this purpose.