Gas emanating in active volcanic and tectonic areas in China

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There are limited active modern volcanic areas but numerous large active fault zones occurred in Chinese continent. These include active volcanic activity from Tengchong in southwestern, and Changbaishan and Wudalianchi in northestern China. The active tectonic areas are mainly presented by the Tancheng-Lujiang faults (TCLJF) in eastern, and Jinshajiang-Honghe faults (JSJHHF), Xianshuihe fault (XSHF), Longmenshan (LMSF), Anninghe fault (ANHF), and Zemuhe fault (ZMHF) in southwestern China. One of the common features in these fault systems is of strike-slip and mainly compressional tectonic condidtions. Massive earthquakes occurred along the faults zones, including the Wenchuan *Ms*8.0 earthquake occurred along the LMSF on 12th May 2008 and the Tancheng *Ms*8.5 earthquake along the TCLJF on 25th July 1668. It has been observed that massive volatiles are emiting from these active volcanic and fault zones, forming local abnormal hydrothermal systems. Gas chemical and isotopic compositions (in particular He- C system) of the hydrothermal fluids carry important and unique information about the fluid origins and migration processes. Hence, the combination of $^3He/^4He$, $\delta^{13}C_{CO2}$ and $CO_2/^3He$ has been widely and effectively utilized in identifying the sources of the hydrothermal fluids in the areas of earthquakes and volcanoes.

In this study, chemical and isotope compositions of hydrothermal gases from above active volcanic and tectonic areas have been investigated. The observed $^3He/^4He$ ratios, ranging from 0.01 to 5.5 R_a (where R_a is atmospheric $^3He/^4He$ 1.4×10^{-6}), indicate 0–70 % He derived from mantle and 30–100 % from crust. The mantle-derived He is distributed in all studied areas although it's signature is significantly localised. The local highest $^3He/^4He$ ratios might reflect chemical feature of the lithospheric mantle beneath the Chinese continent. The mantle-derived CO_2 is observed in all active volcanic areas whereas the crustal CO_2 is maily characterised along the fault zones. Such differences in gas geochemical characteristics suggest closed relationship with the regional tectonics, volcanism and recent seismic activities.