Deeply-sourced volatile emissions in the continental collision setting of the Tibetan Plateau and adjacent region

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Continental collision settings, such as the Tibetan Plateau and adjacent region, are characterized by widespread active faults and locally occurred active and Quaternary volcanoes. As a result, the release of volatiles (e.g., CO_2 and noble gases) from natural springs is prevalent in these tectonically and volcanically active regions at present. Here we summarized recent research progress on the geochemistry of the deeply-sourced volatile emissions from the Tibetan Plateau and adjacent region. Using $^3He/^4He$, $\delta^{13}C$, and other elemental ratios (e.g., $CO_2/^3He$) of the natural spring gases, we discussed the sources of these volatile elements and the features of deeply-sourced volatile emissions in different tectonic units of the continental collision setting.

We found that the outgassing of deeply-sourced volatiles correlates well with specific geological settings (e.g., active faults, volcanoes, crustal thickness, and regional stress) of the Tibetan Plateau and adjacent region. In southern Tibet and the Himalayan region, there is a northward increasing trend in $^3He/^4He$ values, suggesting a transition from accretionary wedge dominated by crustal degassing to the magmatic front that exhibits mantle helium contributions. Accordingly, the CO_2 degassing is suggested to result from metamorphic decarbonation at variable crustal depths of the India-Asia continental collision zone. The Karakoram fault may be an outlier for the above degassing pattern because of its depth down to the lithospheric mantle. In contrast, the Southeast Tibetan Plateau margin is characterized by significant mantle He and CO_2 degassing, especially for the Quaternary volcanoes in the Tengchong and Simao block and the bending Xianshuihe fault with high strain rates. Unfortunately, few geochemical studies have been conducted for hydrothermal fluids from the central and northern Tibetan Plateau. Nevertheless, the available He-C isotopic data suggest crust-dominated volatile sources similar to those observed in the South Tibetan Plateau. In general, we suggest that the India-Asia continental collision zone can provide complementary insights into solid Earth degassing to continental rifting zones.

Keywords: Crustal degassing, Mantle degassing, Tibetan Plateau

