Fluxes and He-C isotopes of the volcanic-geothermal gases of the Gulu-Yadong rift (GYR), South Tibet: Implications for northward subduction of the Indian continental lithosphere

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Gulu-Yadong rift (GYR) is the largest and longest extensional rift in Lhasa terrane, South Tibet. There are a lot of volcanic-geothermal fields in the rift, making it one of the strongest degassing areas in the India-Asia continental subduction zone. Following accumulation chamber method, we estimated soil CO_2 fluxes of typical geothermal fields (i.e., Jidaguo, Ningzhong, Sanglai, Tuoma and Yuzhai from south to north) in the GYR. Average soil CO_2 fluxes are ca. 20 g m^{-2} d^{-1}, 257 g m^{-2} d^{-1}, 94 g m^{-2} d^{-1}, 32 g m^{-2} d^{-1} and 45 g m^{-2} d^{-1} from south to north, respectively. Combined with the other 3 previously reported soil CO_2 fluxes of volcanic-geothermal fields (Yangying, Yangbajing and Gulu) in the GYR, we estimated the total soil CO_2 output of the GYR, which is ca. 6.99×10^5 t a^{-1}. These high soil CO_2 flux suggests significant geological carbon degassing in continental subduction zone at present. Based on the geochemical charateristics of the volcanic-geothermal gases from the GYR, both $^3He/^4He$ ratios (0.04–1.02 R_A, R_A is the $^3He/^4He$ of air) and $\delta^{13}C$-CO_2 values (–14.78 ‰ to –0.10 ‰) of hot spring gases display progressively increasing tends from south to north, implying spatial variations in crustal rocks and tectonics mechanism along the GYR. In details, the progressively increasing $\delta^{13}C$-CO_2 values from south to north might be related with transition of contributing crustal lithology from silicate rocks in the south to the sedimentary carbonate rocks in the north along the GYR. Additionally, most of the $^3He/^4He$ are higher than 0.1 R_A, implying significant mantle volatile contribution, and the progressively increasing $^3He/^4He$ from south to north might be related with the northward subduction of the Indian continental lithosphere.