Degassing of CO_2 along the Xianshuihe fault zone in the eastern Tibetan Plateau

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Abstract:

A total of 2000 CO_2 flux measurements were carried out along 93 transects across the Xianshuihe fault (XSHF) in the eastern Tibetan Plateau, in order to identify various factors that control degassing of CO_2 and to understand regional-scale CO_2 leakage processes in fault systems. CO_2 flux anomalies were mostly observed along the fault traces. The helium and carbon isotopic systematics of 19 gas samples taken from 19 sites running are investigated along XSHF. Total dissolved inorganic carbon was studied in cold and thermal water collected along the XSHF, in order to investigate the source of volatiles and their relationship with the tectonic framework of the XSHF. The data show that the existence of an active degassing activity over a large seismically active sector of the XSHF. $^3He/^4He$ ratios (R) normalized to the atmospheric $^3He/^4He$ ratio ($Ra=1.39\times10^{-6}$) and corrected for the atmospheric contamination (R/Rac), range from 0.11 to 2.19. The $\delta^{13}C$ values of total dissolved inorganic carbon (TDIC) ranging from -3.2 to 8.7 ‰ vs. PDB, show the occurrence of multiple gas–water interactions. The mixing between the atmospheric air and a crustal source and the gas–water interactions occurring at various extents appear to be the main control on the observed He–C systematics. The $\delta^{13}C$ values of soil CO_2 are -25.0 to -18.6 ‰ without correlation with CO_2 efflux values, which suggest that CO_2 flux anomaly is caused by fault-related biogenic gas flow. Large mantle-derived helium contributions were observed from several sources along the XSHF. These indicate that fault zones play an important role both in transferring mantle helium to the surface and in causing fault-related biogenic gas flow. The anomalous CO_2 flux sites may be used to start up a long-term fluid geochemical monitoring of this seismically active area and detect the temporal and spatial variations of the circulating fluids to gain a better insight on the relationships between the fluid geochemistry and the activities of the local faults

Keywords: Degassing, Soil CO_2 Flux, Helium isotope, Fault， Tibetan Plateau