Geochemistry of gas seeps from Haiti: Evidence of plate boundary faults and underthrusting of oceanic crust

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Haiti lies on the boundary of the Caribbean and North American plates. Plate motion is partitioned between two major transcurrent and compressive faults systems: the Septentrional-Oriente Fault Zone (SOFZ) in the north and the Enriquillo-Plantain Garden Fault Zone (EPGFZ) in the south, while much of the convergence is accommodated by thrusts in the Trans-Haitian Belt (THB). The devastating earthquake of 2010 highlighted the need for a better understanding of the fault geometry and their interactions.

We have sampled bubbling cold gases from the EPGFZ and THB faults over several years and determined the isotopic composition. Helium isotope ratios range from 0.8 to 8 R_a, indicating that mantle derived volatiles are ubiquitous. The absence of regional recent volcanism and the low heat flux indicate that the faults are rooted in the mantle and act as pathways for the migration of mantle-sourced volatiles through 20 to 40 km of crust. This is consistent with the EPGFZ faults marking plate boundary and define the eastern boundary of the Gonave microplate (that has so far eluded geophysics). The occurrence of abiotic methane ($\delta^{13}C$ = -10‰, δD = -46‰) and mantle-derived helium ($^3He/^4He$ = 7-8 R_a) in fluids from the southernmost thrust of the HTB is evidence of the association of mantle wedge and serpentinization of oceanic-type crust, probably corresponding to the Caribbean Large Igneous Province (CLIP). This suggests that the northern edge of the "Plaine du Cul-de-Sac" delineates the under-thrusting front of the CLIP series below the island-arc basement of the North Caribbean deformed belts (Great Arc of the Caribbean).

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