

Helium, Carbon and Argon in a Local Context: The Lake Kivu Area, East African Rift

D. Tedesco¹, R.J. Poreda², F. Tassi³ and O. Vaselli³

¹ Department of Environmental Sciences, University of Naples 2, Caserta, Italy

² Department of Earth and Environmental Sciences, University of Rochester, New York, USA

³ Department of Earth Sciences, University of Florence, Italy

On January 17, 2002 the city of Goma was partly destroyed by two of the several lava flows erupted from a roughly N-S oriented fracture system formed along the southern flank of Mt. Nyiragongo, DRC (Democratic Republic of Congo) [1]. A humanitarian and scientific response was immediately organized by international, governmental and non-governmental agencies coordinated by the United Nations [2]. Among the different scientific projects undertaken to study the Nyiragongo volcanic system and mechanisms that triggered this and possible future eruptions, we focused on chemical and isotopic analysis of gas discharges inside the Nyiragongo volcano and its surrounding areas. Gas samples from the summit crater have a clear mantle affinity in $^3\text{He}/^4\text{He}$ ($R/R_{\text{air}} \sim 7 \pm 1$) and $\delta^{13}\text{C}-\text{CO}_2$ (from -3.5 to -4.0 ‰) values. Similar mantle-like helium (6.8 - 8.2 R/R_{air}) is found in lake-side CO_2 -rich gas emanations (*mazukus*) with slightly lighter carbon values (from -5.3 to -6.4 ‰) [3]. The magmatic influence decreases at the bottom of Lake Kivu (5.5 - 3.0 R/R_{air}), and strongly in the southern side of the rift and peripheral gas discharges within and outside the rift (from 1.7 to 0.09 R/R_{air}). Similarly, $\delta^{13}\text{C}-\text{CO}_2$ ratios of peripheral gas emissions are lighter (from -7.02 to -8.44 ‰) or much lighter (from -10.48 to -11.63 ‰) than those from the crater, reflecting possible

degradation of organic matter. Our results suggest that the upwelling of mantle fluids is localized in a relatively small zone of the rift between Lake Kivu and Nyiragongo volcano, while crustal and biogenic fluids dominate peripheral and distal areas. This variation seems to be linked to both local and more regional tectonics. Our data do not show evidence of high $^3\text{He}/^4\text{He}$ signatures commonly associated with mantle plumes from this region.

References

- [1] Tedesco D., Papale P., Vaselli O and Durieux J. Nyiragongo U.N., 2002 scientific team field work report on the 17-18 January eruption, 2002. Bulletin of the Global Volcanism Network, 27, 2-5.
- [2] Tedesco, D. 2002/2003 1995 Nyiragongo and Nyamulagira activity in the Virunga National Park: A volcanic crisis. Acta Vulcanol., vol. 14, 149-155.
- [3] Vaselli, O., Capaccioni, B., Tedesco, D., Tassi, F., Yalire, MM., Kasareka, M.C., 2002/2003. The "Evil's Winds" (Mazukus) at Nyiragongo volcano (Democratic Republic of Congo). Acta Vulcanol., 14-15, 123-128