



Volcanic CO₂ and SO₂ emissions along the Colombia Arc Segment (Northern Volcanic Zone)

Joao Lages (1), Marco Liuzzo (2), Gaetano Giudice (2), Alessandro Aiuppa (1,2), Zoraida Chacón (3), Viviana Burbano (4), Luisa Meza (5), Andrea Rizzo (2), Marcello Bitetto (1), and Cristian López (3)

(1) University of Palermo, DiSTeM, Italy (joaopedro.nogueiralages@unipa.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, Palermo, Italy, (3) Servicio Geologico Colombiano, Observatorio Vulcanologico y Sismologico de Manizales, Manizales, Colombia, (4) Servicio Geologico Colombiano, Observatorio Vulcanologico y Sismologico de Pasto, Pasto, Colombia, (5) Servicio Geologico Colombiano, Observatorio Vulcanologico y Sismologico de Popayan, Popayan, Colombia

Carbon (C) and sulphur (S) are two of the most abundant magmatic volatiles in silicate melts. The exchange of these volatiles between the Earth's crust and mantle occurs primarily along subduction trenches, where degassing of volatile-rich magmas results in carbon dioxide (CO₂) and sulphur dioxide (SO₂) emissions to the atmosphere and hydrosphere through active volcanoes. Based on the relative abundance of these volatiles in volcanic gas emitted from the poorly studied volcanoes of Galeras, Purace and Nevado del Ruiz (Colombia, Northern Volcanic Zone) we attempt to characterize the current state of activity along the Colombia arc segment. Compositional data here reported have been acquired intermittently since 2014 at Galeras and Nevado del Ruiz. Since July (2017) a permanent Multi-GAS station has been deployed at Nevado del Ruiz, by far the most active volcano from those included in this study. Volcanic CO₂/SO₂ ratios were estimated as a function of the maximum SO₂ amount measured (plume marker, in ppm) in order to distinguish pure volcanic gas from other natural sources contributing to the gas signal (i.e. diffuse CO₂ soil degassing). At Nevado del Ruiz, for CO₂/SO₂ ratios estimated within measurement windows with ≥ 5 ppm of SO₂ we report an average ratio of ~ 3.13 . For Purace and Galeras values of ~ 10.17 and ~ 44.21 are reported, respectively, with the last one showing the highest variability since 2014 (ratio values as low as 3.37 were reported in October, 2014). In addition, here we constrain the actual contribution of each one of these individual volcanic systems to present-day emissions of volatiles and what they represent overall within the context of the Andean Volcanic Belt. In March, 2017, using a dual UV camera system, we determined an average SO₂ flux of 12.1 ± 1.82 kg s⁻¹ at Galeras (avg. plume speed ~ 8.2 m s⁻¹). In July the same year, a SO₂ flux of 21.2 ± 3.60 kg s⁻¹ (avg. plume speed ~ 12.7 m s⁻¹) was estimated for Nevado del Ruiz. If we consider this value of about 1045-ton day⁻¹ of SO₂, we can estimate that Nevado del Ruiz alone emits approximately 10000-ton day⁻¹ of CO₂ to the atmosphere, thus making it one of the biggest emitters of the all volcanic arc.