



SO₂ and CO₂ gas measurements at Santa Ana and San Miguel volcanoes, El Salvador

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The composition of volcanic gases varies widely between volcanoes and is also dependent on the individual volcano's state of activity. The emitted gases include H₂O, CO₂, SO₂, HCl, HF, H₂S, CO, H₂, HBr, HI and Hg, in descending order. A well established remote sensing method to monitor volcanic degassing and eruptive activities is the measurement of SO₂ fluxes, which is often combined with in-situ sampling of SO₂ and other volatiles (CO₂, HCl) and the calculation of the respective gas ratios (e.g. CO₂/SO₂, HCl/SO₂). Those data are used to evaluate the degassing regime, since the gas ratios and emission fluxes evolve during magma decompression according to the individual volatile solubilities.

Santa Ana and San Miguel are volcanoes along the Central American Volcanic Arc, where the magmatism is related to the near-orthogonal convergence of the Caribbean Plate and the subducting Cocos Plate. Both volcanoes belong to the most active ones in El Salvador, with their SO₂ emissions varying between of 11 - 609 tons per day for Santa Ana with an average of 221 tons per day during 2018, and a range between 21 - 1379 tons per day for San Miguel with an average of 326 tons per day for the same year. Since 2008, both volcanoes are monitored within the Network for Observation of Volcanic and Atmospheric Change (NOVAC), which continuously monitors their SO₂ emissions. However, these volcanoes are still poorly studied with only a few published gas data (Rodríguez et al. 2004, Olmos et al. 2007, Barrancos et al. 2008, Colvin et al. 2013, Laiolo et al. 2017), reporting usually (only) SO₂ emissions. In January and February 2014, CO₂, SO₂, HCl and HF output rates were measured at San Miguel volcano using a MultiGAS instrument, a FLAME station and a solar ocular FTIR. The average of CO₂/SO₂, HCl/SO₂ and HF/SO₂ mass ratio reported were 0.95, 0.13 and 0.016, respectively, in fact representing the first ever measurements of CO₂, HCl and HF from San Miguel (Granieri et al., 2015). Accordingly, Hasselle et al. 2017 presented the first compositional data for Santa Ana's gas plume (CO₂, SO₂, H₂S and H₂), measured in March 2017. As preliminary results a CO₂/SO₂ ratio between 21 and 99 (plateau and lake shore, respectively), and a H₂/SO₂ ratio between 0.34 (lake shore) and 2.44 (plateau) were reported.

In this study, we present and compare SO₂ long-term data of San Miguel and Santa Ana obtained from the NOVAC stations (2008-2017) and new data gained from in-situ measurements using a multi-sensor instrument obtained during a field campaign in El Salvador in January - February 2019. The aim of the study is an improved characterization of these two volcanic systems. The extended data set will be discussed in context with the former reported data and visual volcanic activity observations and the regional geological settings.