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Eighteen years of diffuse CO_2 monitoring at Cerro Negro volcano, Nicaragua

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Cerro Negro volcano is one of the most active basaltic volcanoes belonging to the active Central American Volcanic Arc. Cerro Negro first erupted in 1850 and has experienced 21 volcanic eruptions with inter-eruptive average periods between 7 and 9 years. Since the last eruption on August 5, 1999, a collaborative research program between INETER and ITER/INVOLCAN has been established for monitoring volcanic activity through diffuse CO_2 emission surveys. Here we present the results of fifteen soil CO_2 efflux surveys by the closed accumulation chamber method (Parkinson, 1981) at Cerro Negro volcano. Diffuse CO_2 emission surveys have been carried out to evaluate the spatial and temporal variations of diffuse CO_2 degassing rate in relation to the eruptive cycle of Cerro Negro volcano. The first survey was performed in December 1999, just 3 months after the 1999 eruption, with a diffuse CO_2 emission output estimated on 1,869 $\pm$ 197 t·d^{-1}. Three years after the eruption, the second survey was performed in March 2003, observing a sharp decrease on the diffuse CO_2 to 432 $\pm$ 54 t·d^{-1}. The last survey was performed in November 2017, with 220 sampling sites selected, always depending on the accessibility and the volcanic-structural criteria. Soil CO_2 efflux values ranged from non-detectable ($\sim$0.5 g·m^{-2}·d^{-1}) up to 2,429 g·m^{-2}·d^{-1}. To quantify the diffuse CO_2 emission rate from Cerro Negro volcano, 100 sequential Gaussian simulations (sGs) were performed as interpolation method to construct soil CO_2 emission contour maps. The diffuse CO_2 emission rate for the studied area was estimated in 23 $\pm$ 2 t·d^{-1}. Spatial distribution of diffuse CO_2 values showed a close relationship between higher CO_2 efflux values and fumarolic areas, where high soil H_2S efflux as well as high soil temperatures were measured, suggesting that the degassing process is governed mainly by an advective transport mechanism. The observed relationship between the long-term record of diffuse CO_2 emissions and volcanic-seismic activity indicates that monitoring CO_2 emission is an important geochemical tool for the volcanic surveillance at Cerro Negro.

References

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