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Diffuse CO_2 degassing monitoring of Cerro Negro volcano, Nicaragua

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We report the results of fourteen soil CO_2 efflux surveys by the closed accumulation chamber method at Cerro Negro volcano, Nicaragua. The surveys were undertaken from 1999 to 2016 to constrain the diffuse CO_2 emission from this volcano and to evaluate the spatial and temporal variations of CO_2 degassing rate in relation to the eruptive cycle. Cerro Negro is an active basaltic volcano belonging to the active Central American Volcanic Arc which includes a 1,100 Km long chain of 41 active volcanoes from Guatemala to Panama. Cerro Negro first erupted in 1850 and has experienced 21 eruptive eruptions with inter eruptive average periods between 7 and 9 years. Since the last eruption occurred on 5 August 1999, with erupted lava flows and ash clouds together with gas emissions, a collaborative research program between INETER and ITER/INVOLCAN has been established for monitoring diffuse CO_2 emissions from this volcano. The first survey carried out at Cerro Negro was in December 1999, just 3 months after the 1999 eruption, with a total diffuse CO_2 emission output estimated on 1,869 $\pm$ 197 td^{-1}. The second survey carried out in March 2003, three years after the eruption, yielded a value of 432 $\pm$ 54 td^{-1}. Both values that can be considered within the post-eruptive phase. The last survey performed at Cerro Negro was in November 2016, with an estimated diffuse CO_2 emission of 63 $\pm$ 14 $t{\cdot}d^{-1}$and soil CO_2 efflux values ranging from non-detectable ($\sim$0.5 g m^{-2} d^{-1}) up to 7264 g m^{-2} d^{-1}. The long-term record of diffuse CO_2 emissions at Cerro Negro shows small temporal variations in CO_2 emissions with a peak in 2004 (256 $\pm$ 26 td^{-1}) followed by a peak in seismicity. Except this value, the rest of estimated values can be considered within the inter-eruptive phase, period during which a decreasing trend on the total diffuse CO_2 output has been observed, with estimates between 10 and 83 $t{\cdot}d^{-1}$. Regarding to the spatial distribution of diffuse CO_2 values, most of relatively high CO_2 efflux values were measured along the 1995 and 1999 craters together with higher soil H_2S efflux and soil temperatures, and always close to the fumarolic areas, suggesting a structural control of the degassing process. 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.