



## **Premonitory geochemical and geophysical signatures of volcanic unrest at Tenerife, Canary Islands**

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Tenerife is the largest volcanic island of the Canarian archipelago, and the most recent eruption took place along the NW rift-zone in 1909, Chinyero volcano. Changes on the seismicity pattern in and around Tenerife island was recently registered by the IGN's National Seismic Network from the middle of 2001 to the end of 2003. Monthly located seismic events in and around Tenerife was about  $<1$  from 1997 to the middle of 2001. On the contrary, this number experienced a significant increase about 6 monthly seismic events from the middle of 2001 to the end of 2003. Firstly most of this low magnitude seismic events ( $< 3.0$ ) recorded during this period were considered to be related to an improve of the IGN's seismic network in the Canaries since broad band seismometers were installed in 2001. After a careful evaluation of the temporal evolution of geochemical and geophysical observations from the period of 1997-2003, we suggested that magma movement might be occurring in the subsurface of Tenerife and this hypothesis was communicated to President of Tenerife Island as well as to several Spanish Scientific colleagues by an e-mail sent on March 24, 2004. This hypothesis was mainly formulated after analyzing the secular variation of diffuse  $CO_2$  and  $H_2S$  degassing rate from the summit cone of Teide volcano, where occurs the most obvious geothermal features in the surface environment of Tenerife. Diffuse  $CO_2$  degassing surveys at the summit cone of Teide volcano are yearly performed during the summer periods since 1997. The total output of diffuse  $CO_2$  degassing normal value for this 0,6 Km<sup>2</sup> study area is estimated about 70-100  $td^{-1}$ , but a peak value of 383  $td^{-1}$  was registered during the 2001 survey. After this observed anomalous diffuse  $CO_2$  emission rate, seismic activity changes were recorded in and around Tenerife island. Continuous monitoring of soil  $CO_2$  flux at the summit cone of Teide volcano showed also temporal changes which are clearly not related to seasonal variations.

From April 1999 to June 2001, the soil  $CO_2$  flux mean value was  $3.9 \text{ Kg m}^{-2} \text{ d}^{-1}$  and this mean value experienced a relatively increase up to  $6.6 \text{ Kg m}^{-2} \text{ d}^{-1}$  from July 2001 to December 2003. These observed continuous monitoring data on soil  $CO_2$  flux were also well temporally correlated with changes on seismic activity. During the 2000 survey, ITER volcano research team started its research activities on diffuse  $H_2S$  emission from volcanic systems. The results from the 2000, 2001 and 2003 surveys at the summit cone of Teide volcano showed an exponential increase on the diffuse  $H_2S$  emission from 0,02 to  $51 \text{ Kg d}^{-1}$  as well as in the  $H_2S/CO_2$  molar ratio of the diffuse degassing at the summit cone of Teide volcano. In addition to these results on diffuse degassing studies, other geochemical observations support the occurrence of magma movement in the subsurface of Tenerife such as: (1) an observed peak of Cl/S molar ratio in condensates from fumarole discharges at the summit cone of Teide volcano in the middle of 2001, (2) the detection of  $SO_2$  in the fumarole gases since 2002 reaching the highest  $SO_2/CO_2$  molar ratio values during the 2004 seismic crises, and the (3) the observed temporal variations of diffuse  $CO_2$  emission rate in and around the NW rift-zone at Tenerife from 2000 to present. Seismicity activity has increased during 2004, especially after the first seismic swarm detected inside Tenerife during April 22-29, 2004. We continue our multidisciplinary volcano monitoring program to improve our early detection signatures systematic related to the actual volcanic unrest at Tenerife.