



SO₂ degassing at Tungurahua volcano (Ecuador) between 2007 and 2013: Transition from continuous to episodic activity

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Abstract

We present continuous SO₂ measurements performed at Tungurahua volcano with a permanent network of 4 scanning DOAS instruments between 2007 and 2013. The volcano has been erupting since September 1999, but on the contrary to the first years of eruption when the activity was quasi-continuous, the activity transitioned in late 2008 towards the occurrence of distinct eruptive phases separated by periods of quiescence. During our study period we distinguish 11 phases lasting from 17 to 527 days separated by quiescence periods of 26 to 184 days. We propose a new routine to quantify the SO₂ emissions when data from a dense DOAS monitoring network are available. This routine consists in summing all the highest validated SO₂ measurements among all stations during the 10 h of daily working-time to obtain a daily observed SO₂ mass. Since measurement time is constant at Tungurahua the “observed” amounts can be expressed in tons per 10 h and can easily be converted to a daily average flux or mass per day. Our results provide time series having an improved correlation on a long time scale with the eruptive phases and with quiescence periods. A total of 1.25 Mt (1.25×10^9 kg) of SO₂ has been released by Tungurahua during the study period, with 95% of these emissions occurring during phases of activity and only 5% during quiescence. This shows a contrast with previous volcanic behaviour when passive degassing dominated the total SO₂ emissions. SO₂ average daily mass emission rates are of 73 ± 56 t/d during quiescent periods, 735 ± 969 t/d during long-lasting phases and 1424 ± 1224 t/d during short-lasting phases. Degassing during the different eruptive phases displays variable patterns. However, two contrasting behaviours can be distinguished for the onset of eruptive phases with both sudden and progressive onsets being observed. The first is characterised by violent opening of the conduit by high energy Vulcanian explosions; and the second by a progressive, in crescendo, development of the activity. The first case is becoming more frequent at Tungurahua making the volcano more dangerous and less predictable.

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