Geophysical Research Abstracts
Vol. 14, EGU2012-5076, 2012
EGU General Assembly 2012

Stress field control of magma output and eruption dynamics inferred from the historical record and InSAR-measured deformation at Nyamuragira

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Nyamuragira has had 31 eruptions of flank lava flows in the last 110 years. The volumes and durations of these eruptions reveal a distinct change in behaviour of the volcano since 1977. The average output rate of magma as lava flows increased by a factor of $\sim$ 2.4at that time. The period from 1901 to 1977 was characterised by long-duration (> 80 days) eruptions from dykes oriented parallel to the local Rift Zone ($\sim$ NE-SW) whilst from 1980 to 2011 the eruptions have been mainly of short-duration (< 80 days) from dykes oriented perpendicular to the Rift Zone (NNW-SSE). The deformation associated with the emplacement of these co-eruptive dykes since 1996 has been measured by InSAR. This generally shows permanent strain fields consistent with mainly NNW-SSE oriented dyke emplacement in the top few kilometres. Pre-eruption elastic deformation associated with increased central magma storage is of much lower magnitude than the co-eruptive field (1-2 cm uplift over 6 months prior to the 2010 eruption at depths > 3 km), but narrow rift-like subsidence occurs centrally around the caldera at rates of 3-5 cm/year after eruption. Interplay of the stress field generated by the volcano and regional tectonics is considered to affect the longevity of the two observed eruption types with the Rift-parallel eruptions lasting longer in a stress field dominated by the regional component. The switch from one regime to the other in 1977 seems to have occurred as a result of a large N-S dyke being emplaced at neighbouring Nyiragongo volcano and which favoured more magma reaching the surface than being intruded.