The opening of vents like decompression valves of the hydrothermal system at Turrialba volcano, Costa Rica

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Between 1996 and 2009, Turrialba volcano, Costa Rica, reactivated, with the culmination on January 5th, 2010 with a phreatic (hydrothermal) explosion that opened a large vent. This vent has allowed since then to passively decompress the volcanic system as suggested by the large increase in the SO2 flux observed between January 2010 and May 2011, followed afterwards by a marked decrease on the SO2 flux, even when a small but noticeable second vent opened in early 2011. The opening of the 2010 vent has been attributed to movement of fluids from deep to shallow levels through cracks which allowed the migration of a hot magmatic volatile phase. On January 12th, 2012, a new vent opened possibly in response to the pressurization of a shallow hydrothermal system, as suggested by the absence of changes in the seismic patterns and the short-lived enhancement in the flux of heat, CO2 and H2S that diffused through the soil. This event may have triggered a deeper decompression later on January 18th which produced seismic tremor accompanied with the release of hot gases, water vapor, and non juvenile ash through a confined conduit and with absence of CO2 and H2S diffuse flux anomaly. The near magmatic temperature of gas (around 800°C) suggests that this second degassing event opened the system further.

These three vents are visually assumed to be the main contributors to the plume of Turrialba volcano even if numerous low-temperature (<130°C) sulfur-rich fumarolic fields exist inside and outside the Central and West Craters (about 25,000m^2) in 2012, less than 5% of the summital area). Considering the stability and the range of temperature of the vents (around 600, 600 and 800°C for the 2010, 2011, and 2012 vents, respectively), it is proposed that the 3 vents are an opening through the shallowest hydrothermal system of the volcano, while the low temperature fumarolic fields are the surface manifestation of purely shallow-level hydrothermal activity.

The existence of these vents most likely combined with a decrease in the magmatic input prevented any compression of the edifice in 2012 as suggested by the low seismic activity composed of mostly LPs, few screw shape signals characteristic of gas-rich fluids motion and shallow VTs. Altogether, the decrease of seismicity, SO2 flux, and of the acidity of the total deposition observed since mid 2011 support the hypothesis of the cooling down of the magma body that probably intruded sometime in 2007-2008 or before. Thus, the opening of vents in 2011 and 2012 while the system has been considered opened since the opening of the 2010 vent suggests that they are the manifestation of a saturation of the hydrothermal system capacity to transfer heat and volatiles to the atmosphere. Testimonies prior to the 1864-66 eruption of Turrialba and prior to the 1963-65 eruption of Irazu support this idea as many vents opened for both volcanoes prior to their magmatic eruptions.