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# The evolution of the Poàs magmatic/hydrothermal system in the last decade.

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Prediction of volcanic events and evaluation of volcanic hazard are the main concerns for the volcanological community. Despite the many efforts to clarify the processes leading to volcanic eruptions, constraints on timing, magnitude and intensity on impending volcanic activity are poorly understood. Physical and chemical changes of volcanic fluids are commonly generated by interactions between juvenile (magmatic) and shallow (hydrothermal) components, depending on seismic activity, permeability variations and input of new magmas. Thus, geochemical and isotopic monitoring of volcanic fluid emissions has to be regarded as a reliable tool to verify the status and the evolution of a given volcanic system. In this work we present the results of a geochemical monitoring carried out at Poàs volcano (Costa Rica) in the last 12 years, a period during which severe changes of fumarolic fluid chemistry, accompanied by migration of emitting vents and phreatic eruptions, have occurred. The main aim is to investigate the mechanisms at the source of the modifications affecting this volcanic system.

The basaltic-to-dacitic Poàs volcano (2,708 m a.s.l.) is one of the most active in Costa Rica and is characterized by three N-S oriented craters: Von Frantzius, Botos and the active Laguna Caliente. The latter two host a volcanic lakes: Botos is cold with the latest eruption dating back to ca. 7,500 years ago; Laguna Caliente is one of the most acidic lakes of the world (pH≈0) and is the site where phreatic, phreato-magmatic and strombolian events have frequently occurred since 1828. In 1952, two volcanic vents opened within the Laguna Caliente crater. The first one developed a pyroclastic cone (named as the Dome) that still stands today, while the other one collapsed and formed the Laguna Caliente lake basin. In 1988-1991 the acidic lake dried out revealing sulfur vents and fumaroles with temperatures up to 900 °C. In 1998, when our geochemical survey started, the sampling of fumarolic gases was only concerning a low-flux fumarole (no longer existing) discharging in the southern part of the inner crater. After 1999, the main fumarolic activity moved to the E-NE. Since 2006, the fumarolic activity centered at the interface between the Dome and the acidic lake has progressively increased. Several phreatic events have also been occurred. No significant outlet temperature variations of the fumaroles located near the Dome (always ranging between 90 and 120 °C) occurred until July 2008, when a jet-fumarolic discharge reached a temperature of 700 °C. In June 2010, despite of the increasing difficulties to reach the sampling site, the highest temperature (≈800 °C) was measured since the 1988-1991 crisis. As far as the chemical variations are concerned, in the last 5 years the Dome fumaroles evidence an overall increment of the concentrations of magmatic-derived gases (e.g. SO2, HCl, HF) as well as of the N2/Ar, CO/CO2, H2S/CO2 and CO2/CH4 ratios. The complex interplay between the magmatic and hydrothermal components is likely regulated by permeability variations triggered by enhanced convective heat transfer toward the surface. Overpressuring and hydrofracturaction may be responsible for the observed phreatic events that so far have only produced relatively large vapor blasts and ballistic products affecting the lake sediments. The presence of a spine of magma close to the surface (about 500 m), the increasing values of the outlet temperatures and of the magmatic species in the fumarolic discharges cannot rule out the possibility of more explosive events.