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Spatial shifts in fumarolic degassing at Poás volcano: Phreatic Activity in the Ultra Acid Crater Lake versus Subaerial Degassing

MARÍA MARTÍNEZ¹, ERICK FERNÁNDEZ¹, MANFRED J. VAN BERGEN²

¹ Volcanological and Seismological Observatory of Costa Rica Universidad Nacional(OVSICORI-UNA), Heredia, Costa Rica, mmartine@una.ac.cr

² Faculty of Geosciences Utrecht University, Utrecht, The Netherlands, vbergen@geo.uu.nl

Poás stratovolcano, located in the central mountain range of Costa Rica, hosts a highly dynamic hyper-acid crater lake at its summit. This is one of the most active crater lakes on Earth. Throughout historical times the locus of main fumarolic vents has shifted between the lake and the composite pyroclastic cone (CPC), a structure at its southern edge known as “the Dome”. Shifts from the CPC to the lake are associated with periods of phreatic activity that alternate with periods of quiescence, whilst shifts in opposite direction are accompanied by increases in thermal and volatile output through the CPC. Phreato-magmatic events at Poás volcano are rare. The latest was documented in 1953-1955, when the CPC was emplaced. Currently, the volcano is in a stage of moderate phreatic activity in the lake and high output of heat, gases, and aerosols around the CPC.

This presentation highlights the strongly fluctuating behaviour of the acid lake and the CPC, as appears in time series of monitored physico-chemical parameters, together with data on volcano seismicity and other geophysical signals such as microgravimetry that have been collected since the late 1970s. These integrated geochemical and geophysical signatures are used to determine if the shifts of the main fumarolic vents are due to incidents of localised shallow dendritic magma intrusions or if they express changes in subsurface structures that control degassing pathways of volatiles rising to the surface. We also use these signatures to explore the nature and extent of compositional changes and flux rates of magmatic volatiles released from a shallow reservoir, and the contribution of the country rock to element budgets. The results provide new insights into the degree of gas-water-rock interaction and into the modulating effects of the hydrothermal system underlying the crater lake of Poás.