

Morphological and geochemical features of crater lakes in Costa Rica: an overview

Franco TASSI*, Orlando VASELLI, Erik FERNANDEZ¹⁾, Eliecer DUARTE¹⁾, Maria MARTINEZ¹⁾, Antonio DELGADO HUERTAS²⁾ and Francesco BERGAMASCHI

Department of Earth Sciences, Via G. La Pira 4, 50121, University of Florence (Italy)

¹⁾Volcanological and Seismological Observatory, Nacional University, Heredia (Costa Rica)

²⁾Estacion Experimental de Zaidin (CSIC), Prof. Albareda 1, 18008, Granada (Spain)

*e-mail corresponding author: franco.tassi@unifi.it

ABSTRACT

This paper describes the compositional and morphological features of the crater lakes found in the volcanoes of Rincón de La Vieja, Poás, Irazú, Congo and Tenorio volcanoes (Costa Rica). As evidenced by the distribution of the water and dissolved gas chemistry along vertical profiles, the different fluid sources feeding the lakes reflect the present status of each of the volcanic systems. The chemical features of the Caliente (Poás volcano) and Rincón crater (Rincón de la Vieja volcano) lakes are mainly dependent on i) inputs of magmatic fluids from sub-lacustrine fumaroles and ii) water-rock interaction processes. Conversely, the Irazú lake is mainly affected by the presence of CO₂(H₂S)-rich fluids discharged from a hydrothermal system, which masked possible magmatic fluid contributions. Rainfall and organic activity are the main factors responsible for the chemical composition of Hule, Botos, Congo and Tenorio lakes. The chemical and isotopic water composition of Botos, Irazú and Hule lakes have displayed no significant variations along the vertical profiles. In contrast, Caliente lake shows a distinctive chemical stratification, mainly involving F⁻, Cl⁻ and SO₄²⁻. The behaviour of these compounds seems to be governed by both dissolution of highly acidic species, i.e. HF, HCl and SO₂ released from the magmatic environment, and microbial activity. Despite the significant increases with depth of dissolved CO₂ at Caliente and Irazú lakes, the hazard for Nyos-type gas eruptions can be considered negligible, since i) the water volumes are too small and ii) the convective heat transfer limits the CO₂ recharge rate. The relatively high concentrations of dissolved CO₂ measured at the maximum depth of the Hule lake are likely produced by both degradation of organic material and degassing from a deep source. The sporadic episodes of fish deaths recently observed in this lake can be associated with lake overturn processes that have favoured the rise up to the lake surface of deep, oxygen-depleted waters.

Key words: lake stratification, limnic eruptions, hyperacidic lake
