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Connections between hyper-acid crater lakes and flank springs: New evidence from Rincón de la Vieja Volcano (Costa Rica) and implications for lahar hazard assessment

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Rincón de la Vieja, a complex andesitic stratovolcano in NW Costa Rica (1805m.a.s.l.) shows hydrothermal surface manifestations that comprise: 1. A hot hyper-acidic crater lake, which has been a focal point of fumarolic degassing and phreatic- to phreatomagmatic eruptions through historical time and possibly over the last 3500 years; 2. Warm acid-chloride-sulphate springs along the northern slopes of the volcano, and 3. Small lakes and a large geothermal field with bubbling-boiling mud pools, acid-sulfate springs, steaming ground and fumarolic emissions on the western and southern flanks. Frequent eruptions and a persistent emission of volatiles have been recorded throughout historical times: 1765, 1844, 1849, 1851-1863, 1912, 1922, 1920-1955, 1940, 1963, 1966-70, 1983-84, 1985-87, 1991-92, 1995, 1998, 2011, and 2012. Thus, the chances that Rincón enters new phases of phreato- or phreatomagmatic eruptions are high (Alvarado, 2011). Some of the recorded eruptions have triggered damaging lahars.

Series trends for major anions and other physico-chemical and geophysical data for the period February 1992-2014 point to large fluctuations in the influx of heat and magmatic volatiles into the ultra acid crater lake of Rincón (Sáenz, 2007). Physico-chemical properties of the sulfate-chloride hyper-acid lake (T=27-58°C; pH between 1.2 and <0, TDS=24,000-160,000mg/kg) are consistent with a meteoric water body supplied by chemical components derived from hydrolysis of magmatic volatiles and from intense rock leaching. The Cucaracho catchment receives input from warm acid brines with no free-gas phase but carrying a high load of the same components. Acid chloride-sulphate springs (T=27-38°C) that seep on the north flank, ca 2km from the crater, have chemical signatures fairly similar to the acid lake (pH~2-4, TDS=780-1300mg/kg), which suggest a connection with the magmatic-hydrothermal system that feeds the lake. Based on water and heat-balance considerations, chemical and stable-isotope signatures and groundwater transport modelling, it has been proposed that these acid springs represent brine water from the lake-hydrothermal system that is diluted by shallow groundwater permeating tephra layers (Kempter and Rowe, 2000). High-frequency geochemical monitoring of the ultra-acidic lake of Rincón is required but direct access is difficult and dangerous. Thus, in this study we use time series data to test this assumption and establish if the springs could be a viable and reliable alternative for safe geochemical monitoring due to the threats represented by lahars with potentially far-reaching impacts.

-Alvarado, G. 2011. Los volcanes de Costa Rica: Geología, historia, riqueza natural y su gente. EUNED, 386 p.
-Kempter, K.A., Rowe, G.L. 2000. Leakage of active crater lake brine through the north flank at Rincón de La Vieja volcano, northwest Costa Rica, and implications for crater collapse. J. Volcanol. Geotherm. Res., 97: 143-160.
-Sáenz, W. 2007. Análisis de muestras de aguas del lago cratérico ultraácido del volcán Rincón de la Vieja recolectadas entre 1992 y 2006. En: Informe abierto Práctica Profesional Química Industrial. Escuela de Química Universidad Nacional, Heredia, Costa Rica.