Journal of Volcanology and Geothermal Research
Volume 49, Issues 1-2 , January 1992, Pages 23-51

doi:10.1016/0377-0273(92)90003-V Cite or Link Using DOI

Fluid-volcano interaction in an active stratovolcano: the crater lake system of Poás volcano, Costa Rica

Gary L. Rowe, Jr [a, 1], Susan L. Brantley [a], Mario Fernandez [b], Jose F. Fernandez [c], Andrea Borgia [d, 2] and Jorge Barquero [e]

[a] Department of Geosciences, 209 Deike Building, The Pennsylvania State University, University Park, PA 16802, USA
[b] Centro de Investigaciones Geofisicas, Universidad de Costa Rica, RED Sismologia Nacional (UCR-ICE), San Jose, Costa Rica
[c] Departmento Estudios Basicos, Seccion Laboratorio Quimíco, Instituto Costarricense de Electricidad, San Jose, Costa Rica
[d] Jet Propulsion Laboratory, M.S. 183501, 4800 Oak Grove Drive, Pasadena, CA 91109, USA
[e] Observatorio Vulcanológico y Sismológico de Costa Rica, Universidad Nacional, Heredia, Costa Rica

Received 15 January 1991; revised 11 April 1991; accepted 11 April 1991. ; Available online 9 April 2003.

Abstract

Seismic and geochemical data collected at Poás volcano, Costa Rica, since 1978 suggest that temperature and chemical variations recorded in subaerial fumaroles and the crater lake are related to episodic release of heat and volatiles associated with hydrofracturing of the upper margin of the shallow magma body. Power outputs associated with these events approach 600 MW and are superimposed on a baseline energy flux of approximately 200 MW. The baseline heat flux suggests a magma solidification rate of 0.012 km^3/yr and background volatile release rates of 1000 t/d H_2O, 66 t/d, ‹S›, 13 t/d Cl, and 0.5 t/d F. These fluxes are comparable to fluxes of F, Cl and ‹S› exiting the magmatic/hydrothermal system through acidic flank springs and are about a factor of five less than estimated volatile fluxes through summit fumaroles during the high-temperature event of 1981–1983.

Mass balance considerations suggest that heat released at the lake surface is primarily supplied by the ascent of heated brines supplemented by condensation of fumarolic steam. Calculated average seepage rates out of the lake (≈ 450 kg/‹s›) indicate rapid convection of acidic lake brine through underlying lake sediments and pyroclastic deposits. Circulation of the extremely corrosive lake brine through the volcanoelastic material beneath the lake may enhance subsurface permeabilities. Fluxes of rock-forming elements observed in the Rio Agrio basin on the northwest flank of Poás suggest that dissolution and removal of volcano-elastic material occurs at a rate of approximately 1650 m^3/yr. However, estimated sulfur fluxes from the cooling magma body suggest that porosity created by this dissolution could quickly be filled by the deposition of native sulfur.