VS12a-VS12a VS12 Understanding Volcanic Lakes: a Multi-Disciplinary Approach

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Gas emissions from the Hyper-Acid Crater Lake of Poás Volcano, Costa Rica

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Magmatic gases are the primary source of heat and volatiles that sustain warm acidic crater lakes. Yet, the composition of gases emitted from these lakes to the atmosphere has been assessed for only a handful of cases. Since April of 2013, we have been monitoring gas emissions from the crater lake and high T fumaroles at Poás volcano using Multi-GAS. These instruments measure CO_2, SO_2, H_2S, H_2, and H_2O concentrations, allowing derivation of gas ratios. We have also sporadically conducted mini-DOAS walking traverse measurements along the west crater rim to determine SO_2 fluxes.
Our data show that the gas plumes from the lake and fumaroles are clearly distinguishable in both Multi-GAS and mini-DOAS measurements. The fumarolic gases are characterized by CO_2/SO_2 of 0.39±0.11, H_2/SO_2 of 0.12±0.08, and H_2S/SO_2 of 0.12±0.04, which do not vary substantially with time and most likely represent the magmatic gas feeding the lake. The lake gases are more CO_2-rich and poor in reduced gases, with CO_2/SO_2 of 1.1±0.2, H_2/SO_2 of 0.02±0.01, and no detectable H_2S, which indicate that the shallow hydrothermal/lake system scrubs sulfur gases and oxidizes reduced gases from the magmatic volatile input. The preliminary average SO_2 flux from the fumaroles is 144±63 T/day, whereas that from the lake is 57±26 T/day. The CO_2 flux from the fumaroles is comparable to that from the lake at 43±23 T/day and 35±16 T/day, respectively, suggesting that a similar amount of heat is delivered to the lake and fumaroles. During a period of intense phreatic eruptive activity from 24 April to 29 October, we observed lower CO_2/SO_2 in lake gas emissions and higher SO_2 fluxes, suggesting that gas monitoring of hyper-acid volcanic lake emissions may prove an effective method for forecasting phreatic eruptions.