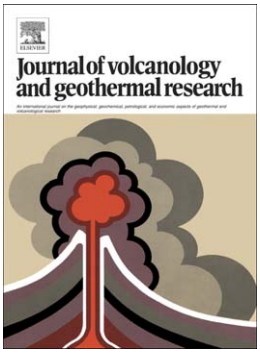

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Volcano-hydrothermal system of Ebeko volcano, Paramushir, Kuril Islands: geochemistry and solute fluxes of magmatic chlorine and sulfur.

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Abstract

Ebeko volcano at the northern part of Paramushir Island in the Kuril island arc produces frequent phreatic eruptions and relatively strong fumarolic activity at the summit area ~ 1000 m above sea level (asl). The fumaroles are characterized by low-temperature, HCl- and S-rich gas and numerous hyper-acid pools (pH<1) without drains. At ~ 550 m asl, in the Yurieva stream canyon, many hot (up to 87ºC) springs discharge ultra-acidic (pH 1-2) SO_4-Cl water into the stream and finally into the Sea of Okhotsk. During quiescent stages of degassing, these fumaroles emit 1000-2000 t/d of water vapor, < 20 t/d of SO_2 and < 5 t/d of HCl. The measurement of acidic hot Yurieva springs shows that the flux of Cl and S, 60-80 t/d each, is independent on the volcanic activity in the last two decades. Such high flux of Cl is among the highest ever measured in a volcano-hydrothermal system. Oxygen and hydrogen isotopic composition of water and Cl concentration for Yurieva springs show an excellent positive correlation, indicating a mixing between meteoric water and magmatic vapor. In contrast, volcanic gas condensates of Ebeko fumaroles do not show a simple mixing trend but rather a complicated data suggesting evaporation of the acidic brine. Temperatures calculated from gas compositions and isotope data are similar, ranging from 150 to 250ºC, which is consistent with the presence of a liquid aquifer below the Ebeko fumarolic fields. Saturation indices of non-silicate minerals suggest temperatures ranging from 150 to 200ºC for Yurieva springs. Trace elements (including REE) and Sr isotope composition ssuggest congruent dissolution of the Ebeko volcanic rocks by acidic waters. Waters of Yurieva springs and waters of the summit thermal fields (including volcanic gas condensates) are different in Cl/SO_4 ratios and isotopic compositions, suggesting complicated boiling-condensation-mixing processes.

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1. Introduction