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Geochemistry of fluid manifistations of the Ebeko Volcano, Paramushir Island (Kurile Islands, Russia).

Elena Kalacheva, Tatiana Kotenko, and Ekaterina Voloshina
Institute of Volcanology and Seismology FED RAS, Petropavlovsk-Kamchatsky, Russian Federation (ukagirka@gmail.com)

The Ebeko volcano (50°41'N, 156°01'E) is located at the northern part of Paramushir Island and composed of several Quaternary volcanic cones. The Neogene volcano-clastic basement occurs below ~200 m asl. The post-glacial cone of Ebeko is composed by lava flows and pyroclastics of andesitic composition. The summit is represented by three craters (Northern, Middle and Southern). The modern phreatic and fumarolic activity of Ebeko started after a strong explosive phreatic–magmatic eruption from the Middle crater in 1934–1935 which ejected about 10^6 t of andesitic ash and bombs. Last eruptive activity of Ebeko volcano began in October 2016 and continues to the present.

Main feature of the hydrothermal activity of Ebeko is the existence of two thermal fields separated in the space. The summit field consists ~ 10 thermal grounds, low-temperature fumaroles (<120 °C) and near-boiling pools with no or weak outflowrates. The second thermal field, Yurievskie springs, is locatedat low elevations, ~550 m asl down to 280 m asl, on the western slope of Ebeko volcano in the canyon of Yurieva River. Gases from different parts of the summit thermal field are all water-rich (97–99 mol%) and show varying contents of HCl and total sulfur and ratios of C/S and H_2S/SO_2. All waters from the Yurievskie springs and Ebeko pools are ultra-acidic, with pH < 2. The Yurievskie waters are of the SO_4–Cl type (SO_4/Cl ratios are ~1:1molar and 3:1 by weight), whereas the SO_4/Cl ratio in Ebeko pools show low (<1) and varying SO_4/Cl ratios. Major and trace element composition of Ebeko-Yurievskie acidic waters is suggesting congruent dissolution of volcanic rocks. 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 250 °C, which is consistent with the presence of a liquid aquifer below the Ebeko fumarolic fields.

Thermal grounds and pools of the summit field are closely associated with the volcano activity. Each period of volcano excitation causes changes in the locations of major fumarole vents, crater lakes, and affects the chemical composition of water and gas. The Ebeko volcano eruption (from 2016 to the present) also triggered changes in the isotope and chemical composition of the Yuryevskie springs.

In this paper we report data on water and gas compositions of samples obtained during the

2016-2019 field seasons and compare partially published data from 2005-2014 field campaigns. This work was supported by the RFBR grant #20-05-00517.