VOLCANIC GAS EMISSIONS FROM THE KURIL ISLAND ARC: GEOCHEMISTRY AND FLUXES

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The Kuril Island arc extending for about 1200 km from Kamchatka Peninsula to Hokkaido Island is a typical active subduction zone with ~ 40 historically active subaerial volcanoes, some of which are persistently degassing. Seven Kurilian volcanoes (Ebeko, Sinarka, Kuntomintar, Chirinkotan, Pallas, Berg and Kudryavy) on six islands (Paramushir, Shiashkotan, Chirinkotan, Ketoy, Urup and Iturup, Figure 1) emit into the atmosphere > 90% of the total fumarolic gas of the arc. During the field campaigns in 2015-2017 direct sampling of fumaroles, MultiGas measurements of the fumarolic plumes and DOAS remote determinations of the SO_2 flux were conducted on these volcanoes. Maximal measured temperatures of the fumaroles in 2015-2017 were 510 °C (Ebeko), 440 °C (Sinarka), 260°C (Kuntomintar), 720 °C (Pallas), 96°C (Berg) and 820°C (Kudryavy). The total SO_2 flux from fumarolic fields of the studied volcanoes was measured as ~ 1800 ± 300 t/d, and the CO_2 flux is estimated as 1250 ± 400 t/d (See details in Table 1).

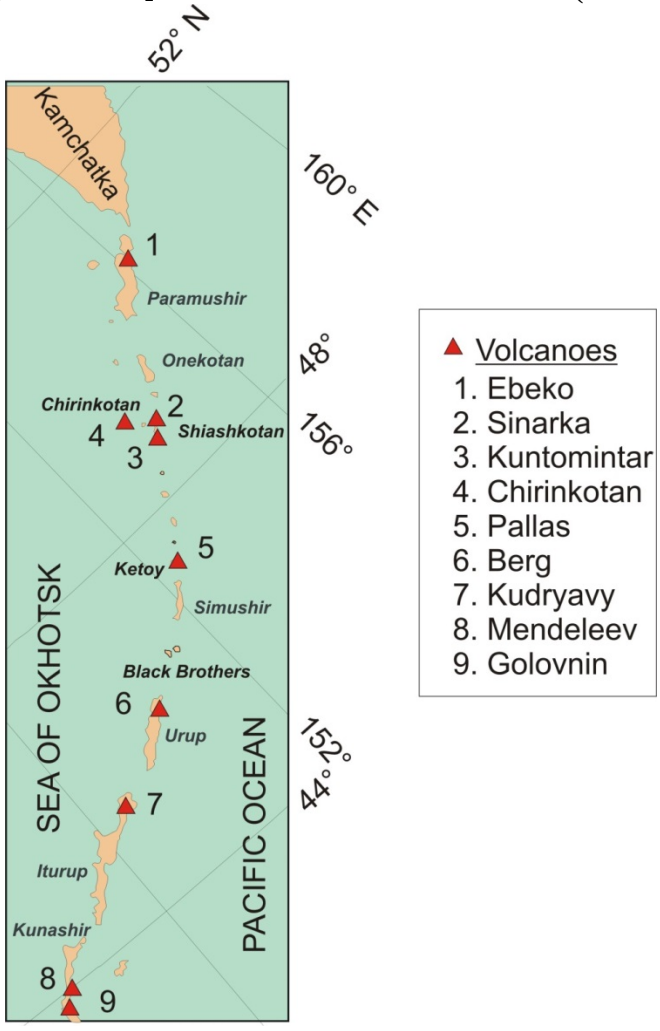

Figure. 1 Location of the studied islands within the Kuril island arc.

Geochemical characteristics of the sampled gases include δD and $\delta^{18}O$ of fumarolic condensates, $\delta^{13}C$ of CO_2, $\delta^{34}S$ of the total sulfur, ratios $^3He/^4He$ and $^{40}Ar/^{36}Ar$, concentrations of the major gas species and trace elements in the volcanic gas condensates. The mole ratios C/S are generally <1. All volcanoes of the arc, except the southernmost Mendeleev and Golovnin volcanoes on Kunashir Island, emit gases with $^3He/^4He$ values of $>7R_A$ (where R_A is the atmospheric $^3He/^4He$). The highest $^3He/4He$ ratios of $8.3R_A$ were measured in fumaroles of the Pallas volcano (Ketoy Island) in the middle of the arc.

Table 1. Gas fluxes from volcanoes of the Kuril arc in 2015-2017 (ton/day). The SO_2 flux was measured by the mini-DOAS technique. Fluxes for other gases are estimated using MultiGas and average C/S weight ratios for the direct sampled high-temperature fumaroles (see details in Taran et al., 2018)

Volcano	Location	Date	SO_2 flux	CO_2 flux	H_2S flux	HCl flux
Ebeko	N 46.06, E 150.07	August 12-15th 2015	100 ± 20			
Ebeko	N 46.06, E 150.07	July 18th, August 14th, 2017	250 ± 30	160 ± 100	74 ± 30	46 ± 15
Kuntomintar	N 48°45', E 154°01'	July 18th 2016	100 ± 30	220 ± 40	35 ± 10	17 ± 6
Sinarka*)	N 48°52', E 154°10'	July 20th 2016	≥ 100	≥ 40	≥ 60	≥ 20
Chirinkotan	N 48.98, E 153.48	August 12th , 2017	250 ± 20			
Pallas	N 47°21', E 152°29'	July 24th , 2016	480 ± 40	150 ± 20	80 ± 10	95 ± 10
Berg	N 50°41', E 156.01'	August 6th , 2017	240 ± 50	843 ± 150	220 ± 70	25 ± 10
Kudryavy	N 45°23', E 148°49'	October 15th and 19th 2016	330 ± 60			
Kudryavy	N 45°23', E 148°49'	August 26th, 29th, September 6th, 29th	370± 50	210 ± 40	110 ± 20	120 ± 20
Total		2016 - 2017	1800 ± 300	≥ 1250 ± 350	> 500	> 310

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