Original Russian Text © A.V. Rybin, M.V. Chibisova, A.V. Degteryov, 2018, published in Vestnik KRAUNTS. Nauki o Zemle, Vol. 38, No 2 (2018), pp. 102-109.
Original text is available at http://www.kscnet.ru/journal/kraesc/article/view/203.

THE 2017 ACTIVITY OF THE KURILE ISLAND VOLCANOES

A.V. Rybin, M.V. Chibisova, A.V. Degteryov

Institute of Marine Geology and Geophysics FEB RAS (Yuzhno-Sakhalinsk), 693022; e-mail: a.rybin@imgg.ru

The paper provides data characterizing the volcanic activity in the Kurile Islands in 2017. The authors studied eruptions of Ebeko Volcano (Paramushir Island), Chirinkotan (Chirinkotan Island) and intensification of activity of Sarychev Peak (Matua Island) and Kudryavy (Iturup Island) volcanoes.

Keywords: Kurile Islands, volcanoes, volcanic activity, eruptions, satellite images, SVERT.

INTRODUCTION

The Sakhalin Volcanic Response Team (SVERT) on the basis of the Laboratory of Volcanology and Volcanic Hazards at the Institute of Marine Geology and Geophysics (IMGG) FEB RAS over the past 15 years has been monitoring routinely the volcanic activity within the Kurile Islands using satellite imagery. The SVERT is aimed at collecting and analysis of all available information (satellite data, visual observation etc.) on active Kurile volcanoes as well as creating daily activity reports (http://www.imgg.ru/ru/svert/reports), which are sent to the interested organizations: Regional public institution «Administration for Provision of Civil Defense Measures, Emergencies and Fire and Disaster prevention» in Sakhalin region, Alaska Volcano Observatory (AVO), meteorological centres at Yelizovo (Kamchatka region) and Yuzhno-Sakhalinsk (Sakhalin region) airports, Volcanic Ash Advisory Centres (VAAC) in Tokyo (Japan) and Anchorage, Washington (USA), meteorological centres in Japan, Canada etc. For on-line monitoring, SVERT uses images from AQUA and TERRA (MODIS), NOAA (AVHRR/POES) satellites provided by The Center for Regional Satellite Monitoring of Environment FEB RAS (http://www.satellite.dvo.ru).

The SVERT also uses data from the IS for Monitoring the Volcanic Activity in Kamchatka and on the Kurile Islands (VolSatView) created by the Insitute of Volcanology and Seismology (IVS) FEB RAS, Space Research Institute of the Russian Academy of Sciences (SRI), the Computre Centre (CC) FEB RAS, and State Research Center «Planeta» (SRC «Planeta») (Gordeev et al., 2016; Efremov et al., 2012).

Since 2016 SVERT has been using data from the Japan satellite Himawari-8 that are uploaded onto VolSatView and updated every 10 minutes being very helpful in volcanic activity monitoring. This gives an opportunity for estimation of certain important parametres, i.e. the onset of eruptions, the height of eruptive columns, rate of ash spread etc. (Girina et. al., 2017). The 2017 short explosive events at Chirinkotan Volcano only recorded by Himawari-8 are an example of such successful help. The peculiarities of these satellite images are described in this paper.

In early October 2017, IMGG FEB RAS in association with and Kamchatka Branch of the Federal Investigation Centre (KB FIC) GS RAS installed a surveillance camera for monitoring ash emissions from Ebeko Volcano (Paramushir Island, the Northern Kuriles) that allowed more efficient monitoring of the volcano located within the immediate vicinity of Severo-Kurilsk town.

In 2017 among 36 active volcanoes of the Kurile island arc, the most active were Ebeko (Paramushir Island) and Chirinkotan (Chirinkotan Island) (fig. 1) that are located on the Northern Kuriles. Besides, a weak activity was observed on Pik Sarychev (Matua Island, the Central Kuriles) and Kudryaviy (Iturup Island, the Southern Kuriles) volcanoes (fig. 1).

THE 2017 VOLCANIC ACTIVITY

Ebeko Volcano (absolute height - 1156 m) is located in the northern part of Paramushir Island, 7 km to the west of Severo-Kurilsk town (fig. 1). This

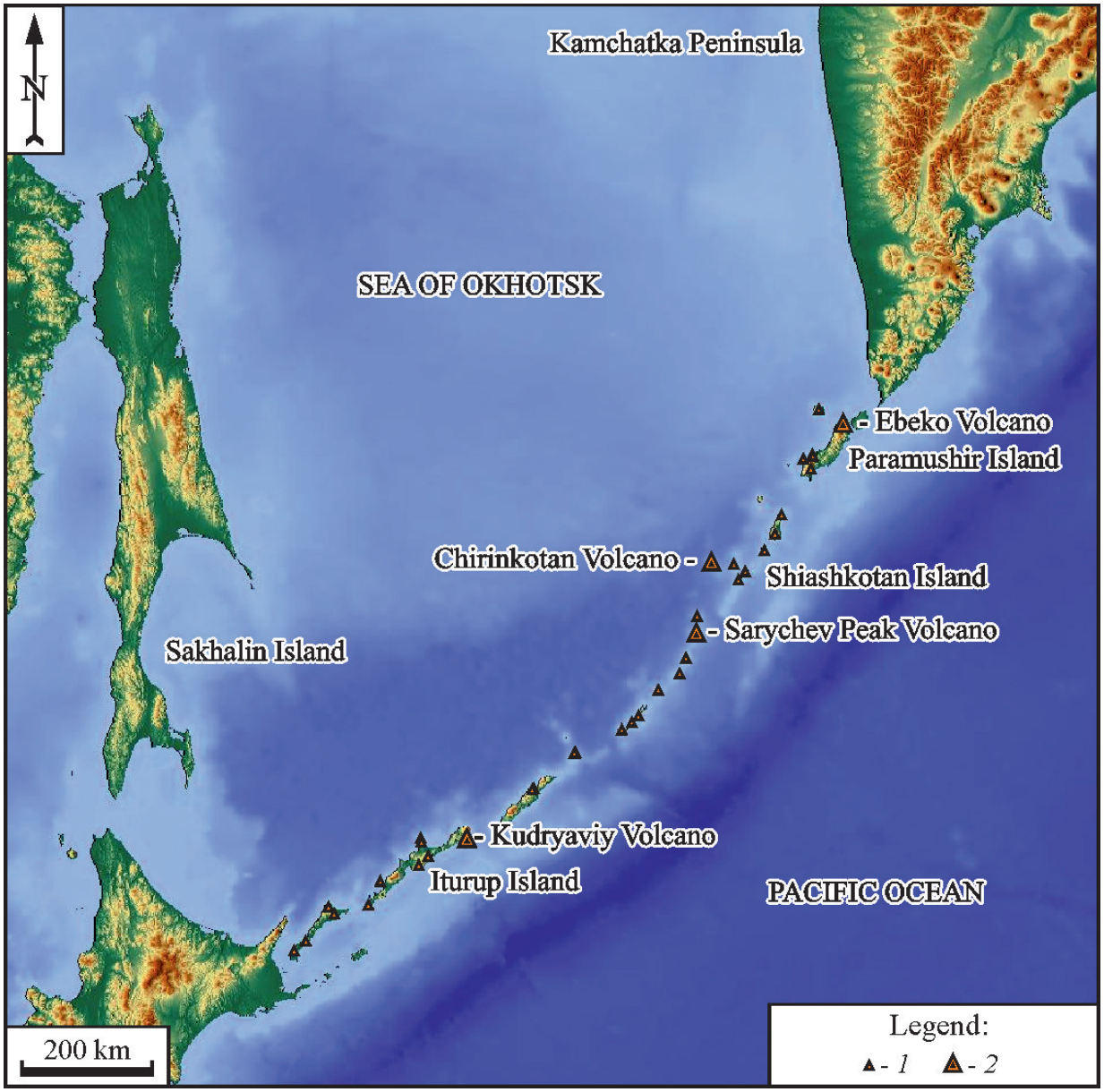

Fig. 1. Active volcanoes of the Kurile island arc: 1. active volcanoes; 2. volcanoes with registered activity in 2017.

is a stratovolcanic cone elongated in the meridional direction with three large craters (Yuzhniy, Sredniy, Severniy) on its top (fig. 2) with a series of lateral explosive craters and explosion funnel (about 10 in total). Historical eruptions of the volcano occurred in 1793, 1833-1834, 1859, 1934-35, 1963, 1965, 1967-1971, 1987-1991, 2009, 2010-2011 (Gorshkov, 1967; Gushchenko, 1979; Kirsanov et al., 1964; Kotenko et al., 2007, 2010, 2012; Izrailov et al, 1969, 1992; Skripko et al., 1966; Siebert et al., 2011).

In the early hours of October 20, 2016, the volcano showed another onset producing steam-and-gas emissions accompanied by a small amount of ash material. Before the end of the year, the volcano had produced occasional weak ash emissions to an altitude of about 1.5 km above sea level; the plumes from the emissions drifted about 8 km mainly northward, northeastward, northwestward, and sometimes southwestward far from the volcano (Rybin et al., 2017b, 2017c).

In 2017, Ebeko Volcano continued weak explosive activity producing stea-and-gas emissions with admixed ash material. During 2017, under favourable weather conditions, ash emissions were observed (fig. 3) rising to an altitude of 1 to 3.5 km above sea level. Plumes as long as 15 km stretched south-eastward, north-eastward, eastward, and sporadically south-westward and westward (http://www.kscnet.ru/ivs/kvert). The volcano was producing eruptions from two zones: from Sredniy crater and Aktivnaya funnel (Kotenko et al., 2018). Since October 2017 we have been using the surveillance camera that allowed more accurate observation of the dynamics, height, and duration of ash emissions (fig. 4*a*, 4*b*).

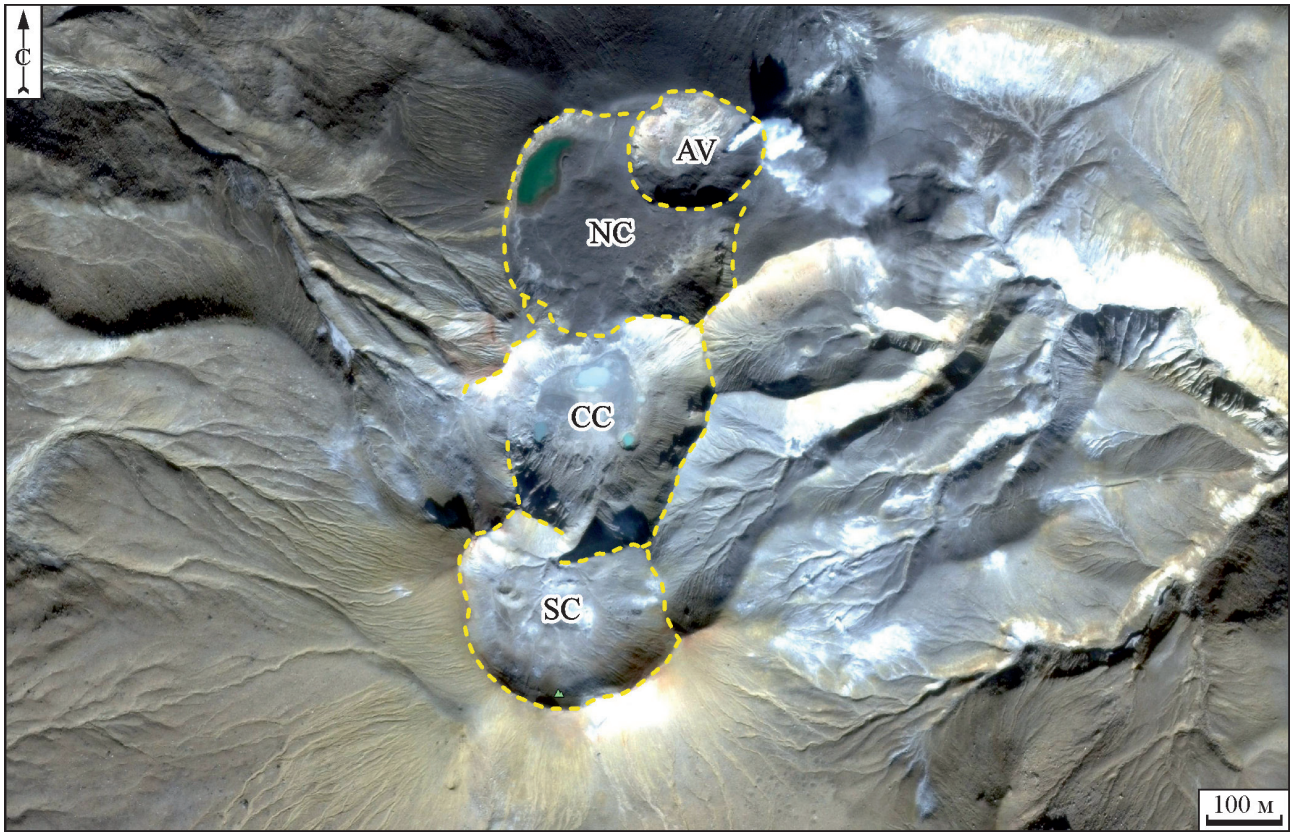

Fig. 2. Diagram showing terminal craters at Ebeko Volcano: АВ – active funnel, СК – Northern crater, ЦК – Central crater, ЮК – Southern crater. Based on the Google Earth satellite imagery (https://earth.google.com/web/).

Fig. 3. Ash emission from Ebeko Volcano, August 10, 2017. Photo by V.A. Rashidov.

Over the year weak ashfalls were observed repeatedly in the town. Poor weather conditions and low emissions made it difficult to use satellite images for monitoring. At present, as of March 2018, the volcano keeps erupting in a similar manner (fig. 4*c*)

Chirinkotan Volcano (absolute height 724 m) forms the largest part of the cognominal island, located 45 km to the north-west of Shiashkotan Island (fig. 1), within the Western volcanic zone (Gorshkov, 1967). The southwestern sector of the stratovolcano was destroyed by an open collapsed-explosive crater, in which an extrusion dome is located, composed with a shallow circus crater. Volcanoe's historical eruptions occurred in 1760, 1848-1889(?), 1855(?), 1979-1980, 2004, 2013-2015, and 2016 (Gorshkov, 1967; Gushchenko, 1979; Ivanov et al., 1979; Rybin et al., 2004; Siebert et al., 2011).

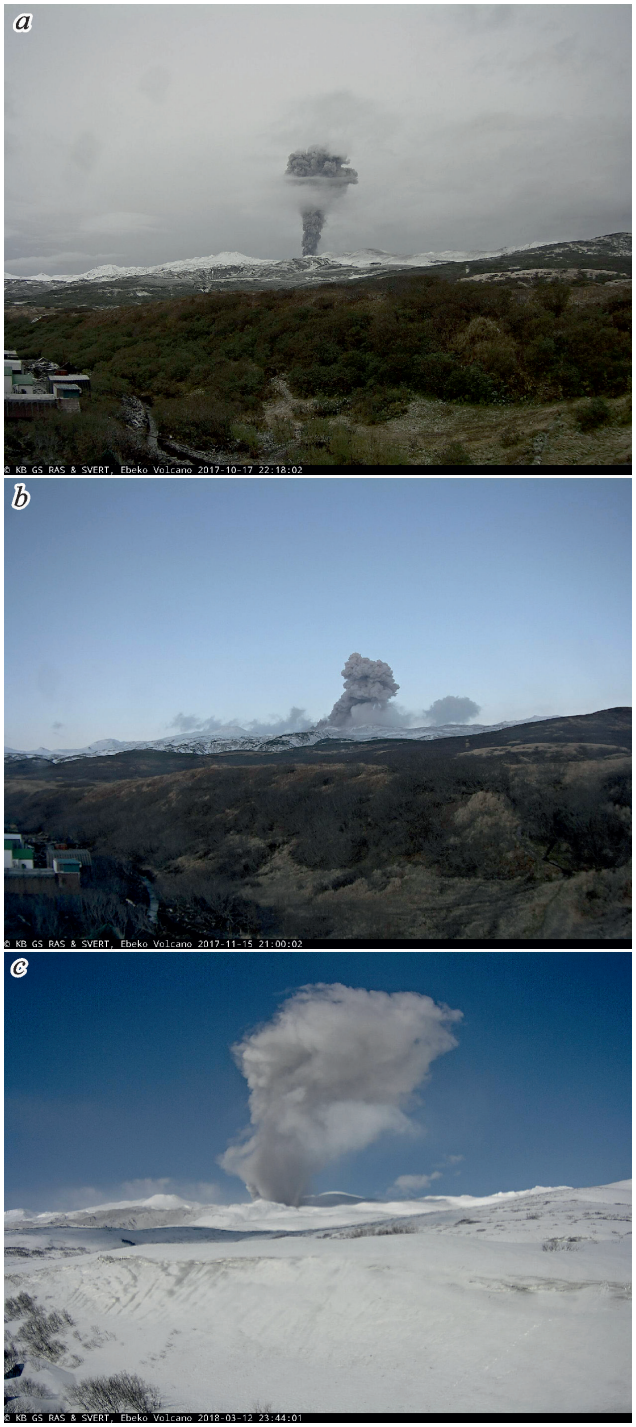

Fig. 4. Ash emissions from Ebeko Volcano, registered by an AXIS surveillance camera (0526-001): October 17, 2017, 22:18 UTC, 2.5 km a.s.l. (*a*); November 15, 2017, 21:00 UTC, 2 km a.s.l. (*b*); March 12, 2018, 23:44 UTC, 2.8 km a.s.l. (*c*).

In 2017 the volcano produced several moderate explosive eruptions that were revealed on satellite images from Himawari-8. Images of moderate density (NOAA (AVHRR/POES), TERRA and AQUA (MODIS)) show no signs of volcanic activity. On January 26, at 15:40 UTC a short ash emission was registered at the volcano, which rose to an altitude of about 3.5 km a.s.l. (fig. 5) and drifted 85 km eastward far from the volcano. On March 1, at 8:40 UTC satellite images showed an ash plume that rose as high as 5.5 km a.s.l. (fig. 5). The eruption cloud drifted at an average speed of 74 km/h 177 km eastward far from the volcano (based on observations over the period 08:40 through 11:20 UTC) (fig. 6). On March 21, at 04:20 UTC Chirinkotan produced an ash emission that rose to an altitude of 6 km a.s.l. (fig. 5). Initially, the eruption cloud travelled 15 km eastward, but then, starting from 04:20 through 06:00 UTC it changed its direction to south-east and stretched as far as 50 km. On March 31, at 23:50 UTC an ash emission was detected rising as high as 7 km a.s.l.; the eruption cloud drifted north-eastward 15 km far from the volcano. On April 7, at 17:50 UTC the volcano produced another ash emission that rose to an altitude of 5 km a.s.l. and travelled 20 km north-eastward. No thermal anomalies prior to and/or after the observed explosive activity were revealed during all the events. As of March 2018, Chirinkotan Volcano remained quiet.

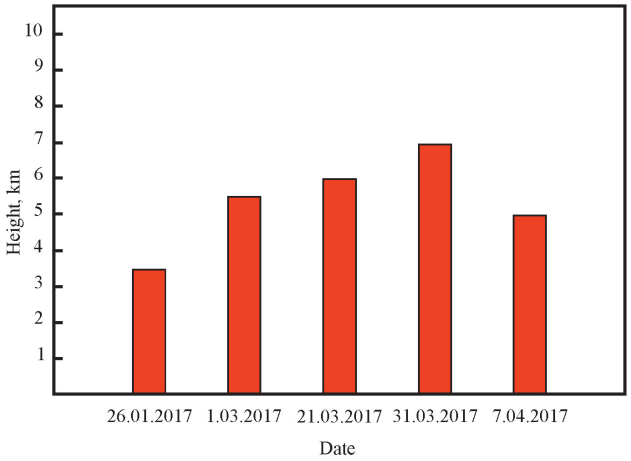

Fig. 5. Maximum height of ash emissions from Chirinkotan Volcano in 2017, based on Nimawari-8 satellite imagery.

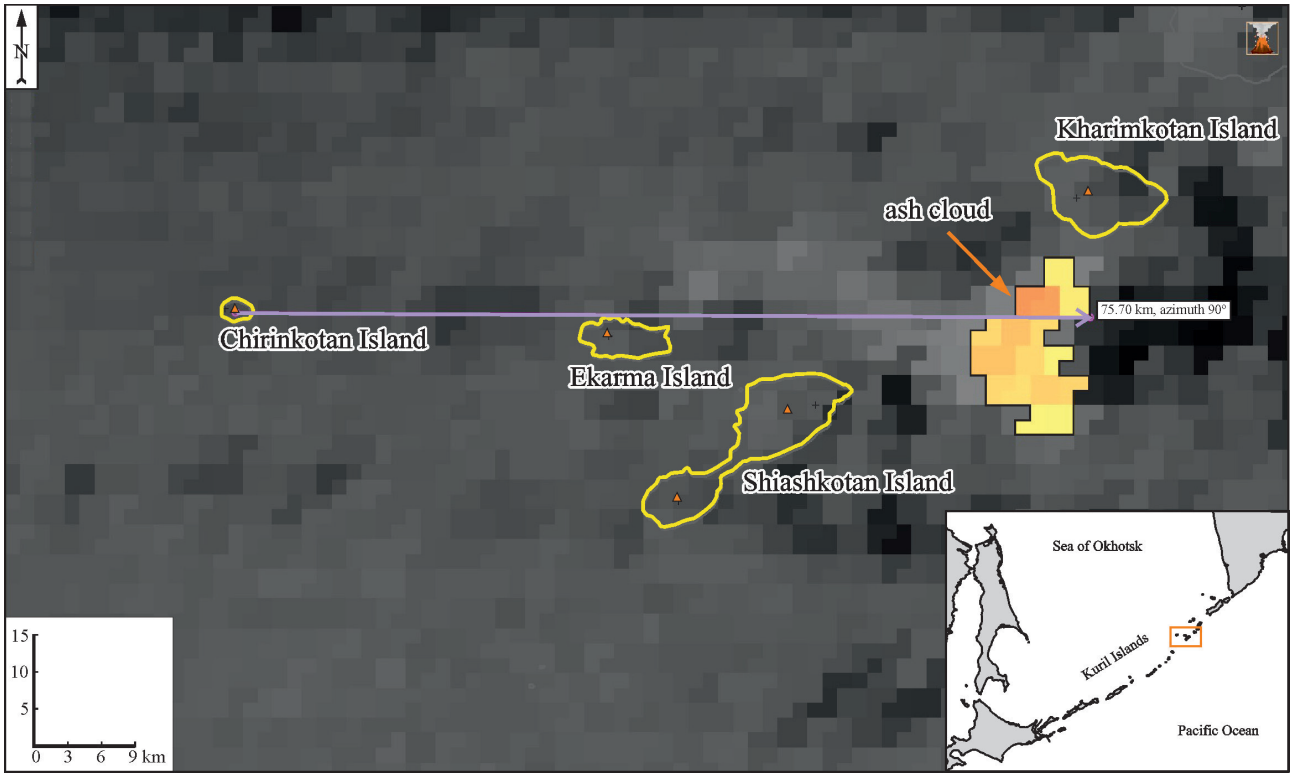

Fig. 6. Length and direction of travel of the ash cloud from Chirinkotan Volcano revealed on Nimawari-8 satellite images based on data from the IS VolSatView on Marcj 1, 2017, 09:40 UTC.

Kudryaviy Volcano (absolute height 1124 m) is located in the northern part of Iturup Island (Medvezhiy Peninsular) (fig. 1). The volcano is a part of an intra-caldera ridge formed by merged volcanic cones. There are 4 craters and a funnel on its top of various ages, structure. and fumarole regime. Kudryaviy Volcano shows steady and strong fumarole activity: maximum gas temperature exceeds 900°C, making favourable conditions for rare-metal mineralization (Danchenko et al., 1999; Korzhinsky et al., 1994). Volcanoe's historical eruptions occurred in 1778-1779(?), 1883, 1946(?), 1999, 2014 (Gorshkov, 1967; Gushchenko, 1979; Rybin et al., 2017б; Siebert et al., 2011).

In 2017, two volcanic events in form of rapidly increased steam-and-gas activity were observed. On February 15, Himawari-8 images revealed a weak thermal anomaly and increased steam-and-gas activity. From July 31 through August 2 another increased steam-and-gas activity was observed by a team of geologists who were in the field-working within the volcano (fig. 7). According to the team member A.V. Solovyov a steam-and-gas column was rising from young Malysh crater to an altitude of 1 km. Later, increased gas temperature on fumarole fields as well as sulfur melting were revealed. At the present time the volcano is producing a vigorous fumarolic activity.

Pik Sarycheva Volcano (absolute height 1446 m) occupies the north-western part of Matua Island (fig. 1). This is a Somma-Vesuvius type of volcano consisted of Pleistocene Matua Volcano with a summit caldera and young Pik Sarycheva cone, which is a typical post-caldera stratovolcano with a summit crater. Volcanoe's historical eruptions occurred in 1765±5, 1878-1879, 1923, 1928, 1930, 1946, 1954, 1960, 1976 и 2009 гг. (Andreyev et al., 1978; Gorshkov, 1967; Degteryov et al., 2011; Rybin et al., 2017; Shilov, 1962).

During the field works on Matua Island in 2017 (Rybin et al., 2017), scientists climbed the summit of the volcano twice, on June 20 and 29, and observed the modern steam-and-gas activity inside the crater. The observation revealed a strong solfataric activity: several strong steam-and-gas emissions were observed within the lava plug that filled the crater's bottom (fig. 8, 9). Moreover, the central part of the plug was considerably settled and covered with a concentric crack with a series of radial cracks on long the edges (fig. 9).

The October 21, 2017 satellite images TERRA (MODIS) showed a discernable thermal anomaly at Pyk Sarycheva Volcano (fig. 10). Later within the month there were new thermal anomalies accompanied by weak steam-and-gas emissions with admixed ash. Since mid-November 2017 the volcano has shown no signs of activity. At present, the volcano remains quiet.

CONCLUSION

In 2017 the most active were the volcanoes of the Northern Kuriles. Ebeko Volcano (Paramushir Island) continued producing a weak explosive activity as

Fig. 7. Renewed activity at Kydryaviy Volcano (view from north-west), August 1, 2017. Photo by V.V. Shitikov.

Fig. 8. Panorama of Pik Sarycheva crater (view from south-east), June 20, 2017. Photo by A.V. Degteryov.

steam-and-gas emissions with admixed ash to altitudes 1 to 3.5 km that had started in 2016. Five moderate explosive events were recorded at Chirinkotan Volcano (Chirinkotan Island) from January to April 2017. They sent emissions to altitudes 3.5 to 7 km a.s.l. that travelled as eruption plumes as far as 177 km. It is noteworthy that ash emissions at Chirinkotan in 2017 were only revealed in Himawari-8 images; no signs of activity were observed in any other satellite images. Besides, new activity was observed at Pik Sarycheva (Matua Island) and Kudryaviy (Iturup Island) volcanoes that were producing increased steam-and-gas activity accompanied by weak emissions.

Activity reports were distributed among all the organizations that ensure safety for local population and air services above the Kurile Islands. Latest updates are also available at the IMGG FEB RAS site (http://www.imgg.ru/ru/svert/reports).

SVERT would like to thank the staff of KB FIC GS RAS for they kind assistance in installation and operation of the surveillance camera in Severo-Kurilsk town

Fig. 9. Lava plug inside the crater of Pik Sarycheva Volcano, June 20, 2017. Photo by A.V. Degteryov.

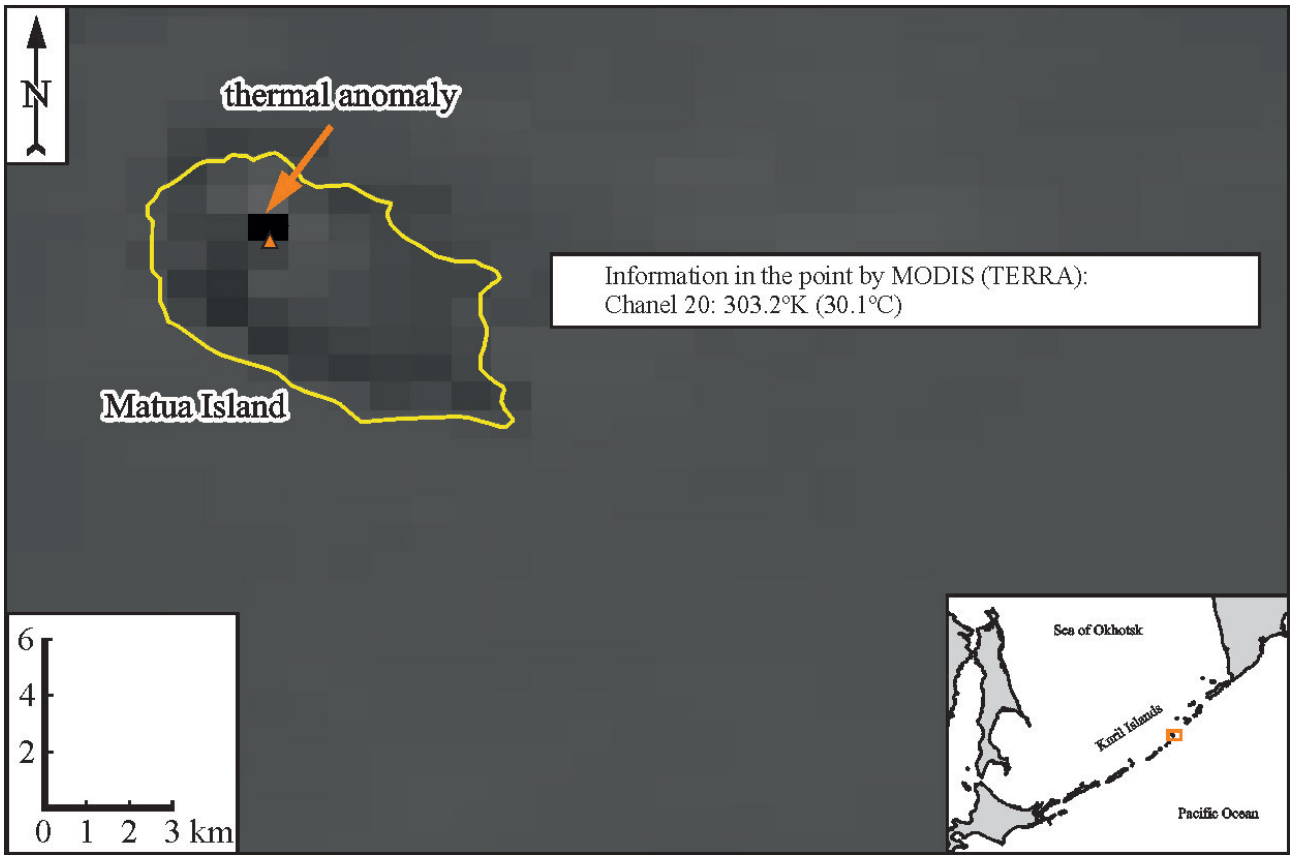

Fig. 10. Thermal anomaly at Pik Sarycheva Volcano (Matua Island), based on data from IS VolSatView and revealed in TERRA (MODIS) satellite image, the 20th channel, October 10, 2017, 00:41 UTC.

SVERT would like to thank the staff of the KBGS RAS for their kind help, installation and maintenance of the surveillance camera in Severo-Kurilsk town, which made it possible to monitor the activity at Ebeko Volcano.

REFERENCES

Andreev V.N., Shantser A.E., Khrenov A.P. et al. The 1976 eruption of Peak Sarycheva Volcano // Bulletin of volcanological stations. 1978. No. 55. pp. 35-40 (in Russian).

Girina O.A., Kramareva L.S., Lupian E.A. et al. Application of Himawari satellite data for monitoring of the Kamchatka volcanoes // Current problems of the Earth remote sensing from space. 2017. V. 14. No. 7. pp. 65-76 (in Russian).

Gordeev E.I., Girina O.A., Lupyan E.A. et al. // J. of Volcanology and Seismology. 2016. V. 10. Iss. 6. pp. 382-394.

Gorshkov G.S. Volcanism of the Kuril Island Arc. Moscow: Nauka, 1967. 288 p. (in Russian).

Guschenko I.I. Eruption of the world volcanoes. Moscow: Nauka, 1979. 473 p. (in Russian).

Danchenko V.Ya., Rybin A.V., Shteinberg G.S. Reniogenic mineralization in the Kurile Islands // Pacific Geology. 1999. V. 18. No. 4. pp. 85-98 (in Russian).

Degterev A.V., Rybin A.V., Razhigaeva N.G. Historical eruptions of Peak Sarycheva Volcano (Matua Island, the Central Kurile Islands) // Bulletin of Kamchatka Regional Association «Educational-Scientific Center». Earth sciences. 2011. No. 1 (17). pp. 102-119 (in Russian).

Efremov V.Yu., Girina O.A., Kramareva L.S. Creation of information service «Remote monitoring of activity of the Kamchatka and the Kuriles volcanoes» // Current problems of the Earth remote sensing from space. 2012. V. 9. No. 5. pp. 155-170 (in Russian).

Ivanov B.V., Kirsanov I.T., Khrenov A.P. et al. The active volcanoes of Kamchatka and the Kuril Islands in 1978-1979 // Volcanology and seismology, 1979. No. 6. pp. 94-100 (in Russian)

Kirsanov I.T., Serafimova E.K., Sidorov S.S. The March-April 1963 eruption of Ebeko Volcano // Bulletin of volcanological stations. 1964. No. 36. pp. 66-72 (in Russian).

Kotenko T.A., Sandimirova E.I., Kotenko L.V. The 2016-2017eruption of Ebeko Volcano (the Kuril Islands). // Bulletin of Kamchatka Regional Association «Educational-Scientific Center». Earth sciences. 2018. No. 1 (37). p. 32-42 (in Russian).

Kotenko T.A., Kotenko L.V., Sandimirova E.I. The eruption of Ebeko Volcano in January-June 2009. (Paramushir Island, the Kuril Islands) // Bulletin of Kamchatka Regional Association «Educational-Scientific Center». Earth sciences, 2010. No. 1 (15). pp. 56-68 (in Russian).

Kotenko T.A., Kotenko L.V., Sandimirova E.I. et al. The eruptive activity of Ebeko Volcano in 2010-2011. (Paramushir Island) // Bulletin of Kamchatka Regional Association «Educational-Scientific Center». Earth sciences, 2012. № 1 (19). pp. 160-167 (in Russian).

Kotenko T.A., Kotenko L.V., Shapar V.N. Increased activity on Ebeko Volcano, Paramushir I., North Kurils in 2005-2006 // J. Volcanology and seismology. 2007. V. 1. No. 5. pp. 3-13.

Menyaylov I.A., Nikitina L.P., Budnikov V.A. Activity of Ebeko Volcano in 1987-1991: the nature of eruptions, the features of their products, and threat to Severo-Kurilsk town // Volcanology and seismology. 1992. No 5-6. pp. 21-33 (in Russian).

Mnyaylov I.A., Nikitina L.P., Khramova G.G. Gas-hydrothermal eruption of Ebeko Volcano in February-April 1967 // Bulletin of volcanological observatories. 1969. № 45. pp. 3-6 (in Russian).

Rybin A.V., Degterev A.V., Dudchenko I.P. Integrated research on Matua Island in 2017 // Geosystems of transition zones. 2017a. No. 4 (4). pp. 21-30 (in Russian).

Rybin A.V., Chibisova M.V., Degterev A.V., Guryanov V.B. Volcanic activity in the Kuril Islands in the XXI century // Bulletin of the Far East Branch of the Russian Academy of Sciences 2017b. No. 1. pp. 51-61 (in Russian).

Rybin A.V., Chibisova M.V., Degterev A.V. Activity of the Kuril Islands volcanoes in 2016 // Bulletin of Kamchatka Regional Association «Educational-Scientific Center». Earth sciences, 2017c. No. 1 (33). pp. 83-88.

Skripko K.A., Filkova E.M., Khramova G.G. The state of Ebeko Volcano in the summer of 1965 // Bulletin of volcanological observatories. 1966. No. 42. pp. 42-55 (in Russian).

Fedorchenko V.I., Abdurakhmanov A.I., Rodionova R.I. Volcanism of the Kuril island arc: geology and petrogenesis. M .: Nauka, 1989. 239 p. (in Russian)/

Shilov V.N. Eruption of Peak Sarycheva Volcano in 1960 // Proceedings of SakhNII. 1962. Iss. 12. pp. 143-149 (in Russian).

*Korzhinsky M.A., Tkachenko S.*1., Shmuovich K.1. et al. Discovery of pure rhenium mineral at Kudriavy volcano // Nature. 1994. V. 369. pp. 51–52.

Rybin A.V., Karagusov Y.V., Izbekov P.E. et al. Monitoring of active volcanoes of the Kurile Islands: Present and future.// The 2nd International Conference on Volcanic Ash and Aviation Safety. June 21-24, 2004, Washington, USA. pp. 55–61.

Siebert L., Simkin T. Kimberly P. Volcanoes of the World. University of California Press, 2011. 568 p.