

Geophysical Research Abstracts  
Vol. 16, EGU2014-1468, 2014  
EGU General Assembly 2014  
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## Explosive Eruptions of Kamchatkan Volcanoes in 2013 and Danger to Aviation

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There are 30 active volcanoes in the Kamchatka, and three of them (Sheveluch, Klyuchevskoy, and Karymsky) continuously active. In 2013, five of the Kamchatkan volcanoes - Sheveluch, Klyuchevskoy, Karymsky, Zhupanovsky, and Mutnovsky - had strong and moderate explosive eruptions.

Strong explosive eruption of volcanoes is the most dangerous for aircraft because in a few hours or days in the atmosphere and the stratosphere can produce about several cubic kilometers of volcanic ash and aerosols. Ash plumes and the clouds, depending on the power of the eruption, the strength and wind speed, can travel thousands of kilometers from the volcano for several days, remaining hazardous to aircraft, as the melting temperature of small particles of ash below the operating temperature of jet engines.

The eruptive activity of Sheveluch Volcano began since 1980 (growth of the lava dome) and is continuing at present. Strong explosive events of the volcano occurred in 2013: on June 26, on October 18, and on December 03: ash plumes rose up to 10 km a.s.l. and extended about 200-400 km, respectively, to the south-west, south-southeast, and north of the volcano. A form of pyroclastic flow deposits with run-out 12 km accompanied these explosive eruptions. Ashfalls occurred at Klyuchi Village (on June 26) and Ivashka Village (on December 03). Activity of the volcano was dangerous to international and local aviation.

Klyuchevskoy volcano had two eruptions in 2013: moderate Strombolian explosive eruption from October 14, 2012, till January 15, 2013; and strong Strombolian-Vulcanian explosive and effusive eruption from August 15, 2013, till December 20, 2013. There were four lava flows to effuse on the north-west, west and south-western volcanic flanks. Probably a flank eruption began at the pass between Klyuchevskoy volcano and Kamen volcano on October 06. Culmination of strong Vulcanian explosive activity of the volcano occurred on October 15-20: ash column rose up to 10-12 km a.s.l. and ash plumes extended to the different directions of the volcano according to cyclonic activity in the this area. Phreatic ash plumes on the fronts of lava flows rose up to 5 km a.s.l. Weak ash falls were noted at Klyuchi Village on October 09 and 13, and Mayskoe Village on October 16. Activity of the volcano was dangerous to international and local aviation.

Karymsky volcano has been in a state of explosive eruption since 1996. The moderate explosive eruption continued during all 2013. Activity of the volcano was dangerous to local aviation. Moderate explosive phreatic eruption of Zhupanovsky volcano occurred on October 23-24, 2013. Ash explosions rose up to 5 km a.s.l. and ash plumes extended for about 120 km mainly to the east and south-east of the volcano. A thickness of ash was about 10 cm at the volcano summit. Activity of the volcano was dangerous to local aviation.

Several moderate phreatic explosions were noted by observers at Active crater of Mutnovsky volcano on July 03. Ash plumes were not noted at satellite images.