

## PECULIARITIES OF THE ACTIVITY OF KLYUCHEVSKOY AND SHIVELUCH VOLCANOES IN 2000-2017 IN CONNECTION WITH THE SEISMIC ACTIVITY OF KAMCHATKA REGION

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Kamchatka Branch of the Geophysical Survey (KBGS) RAS monitors activity of Kamchatka volcanoes using various methods of observations. Research Laboratory of Seismic and Volcanic Activity (RLSVA) of KBGS collected, processed, and systematized the data of seismological, satellite and video or visual observations of the activity of 12 Kamchatka volcanoes, including Klyuchevskoy and Shiveluch, from 2000. The results of the integrated monitoring of volcanic activity with the color code of danger are published daily on the official website of KBGS: <http://www.emsd.ru/~ssl/monitoring/main.htm> (the state registration certificate: # 2014620148 from January 20, 2014). Another major task of RLSVA is also the processing of the all earthquakes in the Kamchatka region in near real time regime (<http://www.emsd.ru/ts>). The investigation of the volcano activity data allowed us to identify possible patterns of their eruptive activity between themselves and in connection with the seismic activity of Kamchatka region.

The following notations were adopted to transform the eruptive activity of the volcanoes into digital format:

- 1) The activity value was equal the ash emission height in kilometers above the eruptive centre. First of all, the height of the ash was fixed according to video or visual observations. If the volcano was obscured by clouds, then the ash emission height was estimated from satellite data and from seismic data.
- 2) If an ash emission has not estimated height, for example a rumble of explosions in the absence of visibility, the activity value was equated to 0.5.
- 3) Additionally, for visualization of eruptive activity of Klyuchevskoy volcano: a strombolian activity (or glow) in the crater was fixed with a value of 0.5, and lava flow - of 1.

In 2000-2017 Klyuchevskoy volcano had eight phases of the eruptive activity accompanied by strombolian eruptions, ash emissions and lava flows with the quasi-period of  $598 \pm 40$  days. Eruptive activity of Shiveluch volcano was analyzed using PSD (spectral power density) procedure. The third peak in power has a period equal to 579 days, which is close to the value of the quasi-period of Klyuchevskoy volcano.

A joint study of the volcano activity graphs showed that correlation coefficient was approximately equal to "0.7" for the period 2005-2016, which is ~ 60% time from 2000-2017. This coefficient indicates synchronism in the eruptive activity of these volcanoes and suggests a certain common regional cause.

To study the seismicity of Kamchatka in 1999-2017 were selected four sequences of the earthquakes in circles with one center at the point located between these two volcanoes and with different semidiameters: 100, 250, 500 and 1000 km. Daily seismic activity for each sequence was measured as decimal logarithm of the energy of the earthquakes occurred in this day. Comparison of the activity graphs of volcanoes with the seismicity of Kamchatka region showed that main maximums of seismic activity graphs with semidiameters of 500 and 1000 km were preceded the main maximums of volcanic activity graphs with ~ 1 year delay.

The synchronicity of the volcanic activity noted above with a quasi-period of about 600 days was violated in three cases, which can be related to the preparation and eruptions of the volcanoes: Plosky Tolbachik and Bezymyanny, which are neighboring to the Klyuchevskoy volcano. Shiveluch volcano is located far from these volcanoes, and its activity does not depend on them. Perhaps the deviation of Klyuchevsky's activity from Shiveluch's activity is observed in cases when magmatic material flows over from the Klyuchevsky system to the neighboring Plosky Tolbachik and Bezymyanny volcanoes before of their new eruptions after prolonged pauses.