EGU21-2939
https://doi.org/10.5194/egusphere-egu21-2939
EGU General Assembly 2021

Subsidence of the lava flow formed during 2012-2013 Tolbachik fissure eruption: SAR data and thermal model

Valentin Mikhailov[1,2], Maria Volkova[1], Elena Timoshkina[1], Nikolay Shapiro[3,1], Vladimir Smirnov[1,2], Pavel Dmitriev[1], and Igor Babayantz[1]

[1]Schmidt Institute of Physics of the Earth, Russian Academy of Sciences, Moscow, Russian Federation (mikh@ifz.ru)
[2]Lomonosov Moscow State University, Faculty of Physics, Moscow, Russian Federation
[3]Institut des Sciences de la Terre, Université Grenoble Alpes, CNRS

During the Tolbachik fissure eruption which took place from November 27, 2012 to September 15, 2013 a lava flow of area about 45.8 km^2 and total lava volume ~0.6 km^3 was formed. We applied method of persistent scatterers to the satellite Sentinel-1A SAR images and estimated the rates of displacement of the lava field surface for 2017–2019. The surface mainly subsides along the satellite's line-of-sight, with the exception of the periphery of the Toludski and Leningradski lava flows, where small uplifts are observed. Assuming that the displacements occur mainly along the vertical, the maximum average displacement rates for the snowless period of 2017–2019 were 285, 249, and 261 mm/year, respectively. On the Leningradski and Toludski lava flows the maximum subsidence was registered in areas with the maximum lava thickness.

To estimate the thermal subsidence of the lava surface we constructed a thermal model of lava cooling. It provides subsidence rate which are generally close to the real one over a significant part of the lava field, but in a number of areas of its central part, the real subsidence values are much higher than the thermal estimates. According to the thermal model when lava thickness exceeds 40 meters, even 5 years after eruption under the solidified surface there can be a hot, ductile layer, which temperature exceeds 2/3 of the melting one. Since on the Leningradski flow, the maximum subsidence is observed in the area of the fissure along which the eruption took place, one could assume that the retreat of lava down the fissure could contribute to the observed displacements of the flow surface. Subsidence can also be associated with compaction of rocks under the weight of the overlying strata. Migration of non-solidified lava under the solidified cover, also can contribute to the observed distribution of displacements - subsidence of the surface of the lava field in the upper part of the slope and a slight uplift at its periphery.

The work was supported partly by the mega-grant program of the Russian Federation Ministry of Science and Education under the project no. 14.W03.31.0033 and partly by the Interdisciplinary Scientific and Educational School of Moscow University «Fundamental and Applied Space Research».