

The base method for prediction of volcanic activity

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F. Omori had written in May 1911, after the first historical instrumental study of seismic and volcanic activity during the 1910 Usu (Hokkaido) eruption: "I believe the problem of forecasting of great volcanic eruption is, in some case, not very difficult". Great Japanese seismologist was right, although his modern followers are not so optimistical. Main feature of volcanic process – excess magmatic pressure. The pressure changes result in deformations of magmatic body and volcanic rocks. There are brittle (disjunctive) and plastic (plivative) deformations. Eruptions of the same volcano may have the clearly marked seismic preparation or not have it at all (for example: the 1975–1976 Tolbachik (Kamchatka) eruption was with good seismic preparation, but 2012 Tolbachik eruption started practically without it). The seismic monitoring may detect brittle deformations as volcanic earthquakes, but it cannot detect plastic deformation. Therefore seismic monitoring must be use together with methods of Earth surface monitoring for successful predictions.

I began own investigations from 1981–1987 Bezymianny (Kamchatka) eruptions with mostly plastic deformations. This eruptions had not significant seismic preparation: only rare weak seismic signals from rock avalanches before explosive eruption and volcanic tremor during it. During the study of 1980–1987 Bezymianny volcano eruptions I discovered the fact of hyperbolic increasing of volcanic activity before explosive-effusive eruptions. My attempts of using these regularities for the forecast were quite successful for several ordinary eruptions and 1985 Bezymianny directed blast (3 forecast levels: 8 months, 19 and 5 days before). Subsequently the studying of patterns for increasing-decreasing of volcanic activity and their comparison with empirical dependencies of the development of various natural processes allowed me to conclude that there is a wide class of self-developing natural processes, the dynamics of which is described by non-linear differential equation of the second order. Parameters of volcanoseismic activity and deformation volumes may be approximated and may be extrapolated by this equation. The correspondence between levels of volcanoseismic parameters and real volcanic phenomena must be found for successful prediction of volcanic eruptions' evolution of observed volcano. Retrospective estimations are executed on the examples of Bezymianny 1955–1970, 1981–1986, Sheveluch 1964, Kizimen 2010–2012 eruptions. They show possibility of the successful predicton of volcanic activity. Time prediction distances are very wide for this method: from 15–30 min for predictions on the base of volcanic tremor monitoring through 1–2 weak for ordinary eruptions up to 2 years (the 2010–c.t. Kizimen eruption). The "approximation–extrapolation" method seems as primitive, but it is the base (fundamental) primitiveness which must be used for predictions of volcanic activity first and foremost.