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Influence of seismic processes and volcanic activity on the formation of disastrous floods

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Traditionally, the main cause of catastrophic floods are considered prolonged heavy rains, which lead to oversaturation of soil moisture and the deposition of precipitation on the surface of the earth. And at the same time there is reason to believe that precipitation cannot be the main cause of floods.

Firstly, we observe a catastrophic floods not in every case of heavy precipitation: moreover, a direct correlation between precipitation intensity and scale of the flooding is not detected. Secondly, a simple calculation shows that the quantity of water, that drops down to the ground with torrential rains, are insufficient to cover the earth's surface such layer of water, where we can talk about the flood (especially catastrophic). In particular, the intensity of normal not tropical rainfall does not exceed 60 mm per hour. Then such a downpour would have to go continuously for at least two days in a row, to cause flooding of a height of 3 m provided a complete impenetrability of the earth's surface. In reality, however, such showers last no more than half an hour.

Thus, it can be argued that the source of water for catastrophic floods fed by ground water, the volume of which is comparable with the volume of all surface water on Earth [1]. Classic examples of surface and groundwater interactions are, on the one hand, springs and artesian wells, and on the other hand, the phenomenon of absorption of precipitation by soil.

In normal conditions underground water is moving by aquifers, penetrating through the pores and cracks in rocks in the conditions of nonstationary/unsteady filtration, forming a 3D network of underground channels in different directions (horizontal, vertical, inclined), including the so-called underground lakes - water basins in underground cavities. Especially strongly these processes are shown in the fractured and karst rocks.

It is also important that the movement of water obeys the laws of hydrostatics and hydrodynamics in terms of specific models of hydraulic systems, but ultimately due to difference of pressures in their respective segments and areas of the transport network. At the exit of the groundwater on the surface such change in pressure is connected both with the state of the actual water flow in underground cavities, or violations of the structure (topology) of 3D-network.

As one of the major and sudden reasons of change of pressure in the underground system can serve seismic processes, including volcanic eruptions (as magmatic and ash). During these processes enormous underground space can be freed from the dense rock. This leads to rapid changes in pressure and that, in principle, a new topology of 3D network and water flows in it. It is important that such dynamic processes occur over huge distances in underground basins of thousands of kilometers [3], of course, with a certain time delay.

In the result of the analysis of large-scale flooding in Russia in 2001-2002, as well as the catastrophic floods in Western Europe, in the Amur region of Russia and in the state of Colorado USA in 2013, a correlation between seismic and volcanic activities and floods, expressed by specific numerical correlation coefficients, has been revealed. For example, knowing the date, location and magnitude of an earthquake, we can identify potentially dangerous territories in the aspect of the probability of occurrence of floods, because the stresses in the crust, spreading from the hypocenter of earthquakes, and their subsequent relaxation are one of the most important factors of floods. Mechanisms of distribution of these stresses are well-studied today [2] unlike their influence on the groundwater.

The defined boundaries of potentially dangerous sites are broad enough; with regard to the direction of distribution of stress, it is about the sectors in 40 degrees (from the line of the movement of the crustal plate)

in the direction from the boundaries of lithospheric plates. Distribution of this impact occurs, as a rule, on a scale from 1.3 to 3.5 thousand km with the ratio of magnitude to the distance from 1.7 to 3.8 points to thousand km.

For further study and zoning potentially dangerous areas, further research is needed for each particular area, taking into account, for example, the properties of the stress distribution medium, and also peculiarities of hydrological conditions on the affected territories.

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