

Earthquake control: utopia or real physical backgrounds?

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The huge human losses (2.32 million for 1900-2015) due to earthquakes and their consequences (tsunamis, landslides, and mudflows), and very disappointing forecast for the 21st century (over 3 million people, despite significant progress of earthquake engineering), an absence of reliable methods of short-term prediction of catastrophic earthquake stimulate the search of alternative ways of seismic hazard mitigation. One of these ways is consideration of a possibility of external man-made impacts on the earthquake source for reduction of magnitude of the impending strong earthquake. The idea of the earthquake control was proposed over half a century ago after discovery of strong correlation between liquid waste pumping into the Rocky Mountain Arsenal well (Denver, Colorado, USA) and the regional seismicity. However, the proposed project for managing earthquakes by controlled fluid injection into the fault was not supported due to high cost and uncertainty of final results. An overview of efforts directed to control of seismic activity performed in Russia demonstrated the spatio-temporal variations of regional seismicity under external artificial vibrations or electromagnetic impacts. However, only statement of such results, an absence of theory and real methodology for reducing the seismic hazard based on the physical impact on the earthquake source resulted in certain skepticism, which is mainly associated with the following provisions. First of all, the artificial «release of excess stresses» declared by defenders of the earthquake control is not applicable to many regions where there no excessive stresses in the focal areas just before earthquakes, but on the contrary, the maximum tangential stresses were close to their minimum value (compared to stresses in the surrounding area). Secondly, the measures for strong earthquake prevention, even being successful for the specific place, can provoke occurrence of catastrophic earthquake due to dynamic fault penetration into intact area. Nevertheless, the skeptics do not consider the man-made prevention of strong earthquakes as a pseudoscientific, but they indicate that in the near future it is too early to employ this approach for the practical use due to a necessity of theoretical studies and field survey of regional geological structures in the regions where an application of the man-made impact on the earth crust is considered. It is difficult to disagree with this, because the existing physical background which undoubtedly demonstrate a possibility of the earthquake control, was developed not sufficiently for practical application. Among the methods of active impact on the earthquake source the most attractive, from the point of view of simplicity, cost, and mobility, is the electromagnetic impact, which possibilities were tested under field (Pamir and Northern Tien Shan) and laboratory conditions of the press equipment and spring-block models. Nevertheless, today only a possibility of earthquake triggering by a powerful pulse of electric current has been verified. However, for prevention of the seismic catastrophe, it is necessary to determine specific parameters of electromagnetic processing of the fault that will allow transferring the mode of its deformation from «stick-slip» sliding to the mode of slow slip events («silent earthquakes») or creep.