

Extended Spectrum of Lithosphere-Atmosphere Treats

I. I. Rokityansky (Institute of magnetism, POB-338/7, Kiev-146, Ukraine; ph. 38-044-474-3251; fax 38-044-444-1020; e-mail: roki@imag.kiev.ua)

Catastrophic volcanic eruptions of historical period (Santorini, Tambora, Krakatau) annihilated local civilizations, made regional destruction (darkness under tephra cloud, toxic gases, tsunami, fires) and moderate global variations of climate without essential influence on global civilization and biota. Meanwhile, paleo data evidence a string of global extinctions occurred during the last 500 Myr. Two concurrent explanations are the most popular: impacts of extraterrestrial bodies and super strong explosive volcano eruptions. As usually, the astronomical objects are better studied than internal terrestrial ones. So, it will be constructive to consider these two causes as well as global nuclear war to cover principal possible threats to the Earth's civilization. For at least two of the three phenomena, the strongest global scale effects are produced by injection of hot dispersed material (dust and gases) into stratosphere and the effects depend on ejected mass. Estimation shows that the ejected mass, measured in Mt, is typically equal 0.1-1 of energy produced by impact (or nuclear explosion), measured in Mt of TNT (energy unit). Tunguska meteorite released an energy of ~10 MtTNT, and injected ~1 Mt of aerosol. Luminosity of the night sky was observed in Northern hemisphere many days. Comparable effects are produced by volcano eruptions with ejected mass 0.5 - 10 Mt. Comet Shoemaker-Levy 9 crashes into Jupiter in 1994 released energies of order a million MtTNT and formed dark spots of aerosol larger than Earth's surface. Over the ensuing weeks and months aerosol clouds transformed into circular belt. Comparable or 1 - 2 orders smaller volcano eruption can be supposed to occur with volcano Toba, Sumatra, 75 thousands years ago. Study of globally distributed sediments in the Cretaceous/Tertiary boundary related to mass extinction of species provides an estimation of the material (aerosol and particles) injected into atmosphere as high as 100 - 500 millions Mt. Such ejecta is inherent for the impact of an asteroid with diameter ~10 km, which can be expected once in 70 - 100 millions years. Major extinctions correspond to this periodicity. Meanwhile, geological data reveal approximately the same periodicity for the rate of volcanite formation. The possibility of volcanic eruptions of such scale cannot be rejected now. Aerosol and dust loading 100 and more millions Mt leads to atmosphere opacity, loss of vision, cessation of photosynthesis, cooling. For spatially local and temporary transient ejection, atmospheric circulation spreads the ejecta around the globe during days and weeks and to all latitudes during months. Life time of aerosol cloud is around half of year (for sulphuric

acid longer, for dust shorter). So, general global winter is unlikely, some windows in the cloud would be left and biota can partly survive. Other consequences (toxins, acid rains, ozone loss, radiation, shock waves, earthquakes, tsunami...) of catastrophic events (eruptions, impacts, nuclear war) are cross-compared and conclusions made: 1) Eruptions/impacts treat global civilization once in several million years or so, nuclear war - maybe in hundreds years. 2) Astronomical monitoring can predict time, place and energy of mayor impacts (and nearby passages) and thus give possibility to apply preventive measures to mitigate or even escape the catastrophe. 3) Near the Earth passage of a massive body should give rise to anomalous tide wave which can disturb lithosphere/asthenosphere system and trigger catastrophic eruptions, earthquakes, tsunami. 4) Poor data base and understanding of the Earth's interior processes gives no ground for reliable and precise prediction of catastrophic events of internal origin, but under adequate efforts future progress should be expected.