

Trigger connections in the geological environment in the process of natural and anthropogenic degassing of the Earth

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ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ УЧРЕЖДЕНИЕ НАУКИ ИНСТИТУТ
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For more than ten years, the IPNG RAS has been conducting comprehensive studies of various dangerous processes that threaten the development of hydrocarbon deposits and other minerals, both on land and in the waters of the World Ocean. Many of them often have direct or indirect cause-and-effect relationships (earthquakes, stratovolcanoes, mud volcanoes, sips of gas and oil, powerful gas emissions, dissociation of gas hydrates, subsidence of the earth's surface, landslides, tsunamis, accidents and catastrophes during the extraction and transportation of hydrocarbons, etc.). In particular, earthquakes are triggers for volcanic eruptions, landslides, gas emissions and the formation of tsunamis, which in turn initiate seismic events themselves. It is possible to build many different chains of trigger processes that lead to significant, including catastrophic changes in the geological environment. Human ingress into the depths of the geological environment through the construction of boreholes, mine shafts and other underground structures (underground mine workings) often leads to emergency and catastrophic situations, many of which are caused by abnormally high reservoir pressures (AHRP) in gas-saturated sediments. The authors have identified general patterns of occurrence of emergency situations associated with high gas saturation of sedimentary strata and emergency gas emissions. It is noted that the approach of underground mine workings with insufficient internal pressure relative to reservoir pressures (especially mines with pressure close to atmospheric) provokes gas emissions and explosions, the elimination of which can take years. The very concept of AHRP has a relative character and it is more correct to talk about the coefficient of anomaly, reflecting the pressure difference in the formation and the bottom of the mine. At the same time, we can talk about the occurrence of local ultrahigh (supergeostatic) pressures (UHP), which in their essence are triggers leading to emissions of drilling tools and mining strikes, accompanied by seismic events. The authors investigated the results of the development of a number of hydrocarbon deposits (Wilmington in the USA, Groningen in the Netherlands, etc.), where the extraction of hydrocarbons was accompanied by severe subsidence of the earth's surface, earthquakes, damage to boreholes, the formation of man-made deposits and other dangerous processes. The phenomena of powerful natural and man-made gas emissions with the formation of giant craters in the Arctic cryolithozone are investigated and the mechanisms of formation of gas-saturated cavities are substantiated, including due to thermokarst processes and gas-dynamic fractures of the formation at UHP. It is shown that gas-dynamic processes with UHP lead to the growth of long-term heaving mounds and catastrophic emissions, spontaneous ignition and gas explosions on the surface of the earth and water of thermokarst lakes, rivers and seas, including the destruction of thick layers of underground ice and ice covers of water areas.