ISSN: 2578-7365

Research Article

Journal of Chemistry: Education Research and Practice

The Quantum Mechanism of Earthquakes and Other Movements of the Earth's Crust on the Example of a Sudden Release of Rocks and Gas from a Rock Massif

Serguei Bychkov

University of British Columbia, Canada

*Corresponding author
Serguei Bychkov, University of British Columbia, Canada.

Submitted: 13 Sep 2022; **Accepted**: 20 Sep 2022; **Published**: 24 Dec 2022

Citation: *Bychkov, S. (2022). The Quantum Mechanism of Earthquakes and Other Movements of the Earth's Crust on the Example of a Sudden Release of Rocks and Gas from a Rock Massif. J Chem Edu Res Prac, 6(2), 442-446.*

Abstract

At the moment, in geophysics, there are several hypotheses explaining especially dangerous processes of movements of the earth's crust - sudden outbursts of rocks and gas from a rock massif. Despite the fact that a variety of macroscopic systems can be accurately described using classical mechanics and electrodynamics, the real mechanism and working model of this phenomenon have never been built. When developing the model of the sudden release of rocks and gas, new approaches and methods were used, different from the description of macroscopic systems. In this article, we have built a quantum version of the theory of the process of the ejection of rocks from a rock mass. In particular, we described the mechanism of the Coulomb explosion based on the quantum model of Mr. Bohr, which occurs in the rocks of the earth's crust with a sharp change in rock pressure, and on the basis of this mechanism, we built a model of the sudden release of rocks and gases. In our opinion, the quantum processes described by us can be sources not only of sudden outbursts and rock gases but also sources of more formidable phenomena - earthquakes and volcanic explosions, because, in our opinion, all disastrous movements of the earth's crust are carried out according to one mechanism, without any exceptions.

Keywords: Quantum, Photon, Electron, Earthquake, Mountain Impact, Volcano

Introduction

Unfortunately, the process of learning the laws of nature does not always move in a straight line and smoothly. When the world's first sudden release of coal and gas occurred at the French Isaac mine in 1834, no one imagined that the mechanism of this formidable process would become a secret for geophysicists and mining engineers that they would not be able to unravel for almost two hundred years. Since then, despite the efforts of many scientists from various universities and special scientific organizations, despite the results obtained, given in dissertations, articles, reports, monographs, despite the data obtained in experiments with hundreds of thousands of crushed rock samples and gas samples taken in mountain conditions, in understanding the geophysical mechanism of the process of rock ejection not much has changed. Nature, as if offended by people for their audacity in seeking to know the truth, closed the secret of the movements of the earth's crust under a secure lock. A prominent Russian geophysicist G. Gritsko spoke briefly but succinctly about the problem of sudden emissions of rocks and gas at the present stage: "Modern scientific ideas about the processes occurring during mining impacts and sudden emissions in mines do not correspond to real processes [1]. It should be noted with bitterness that there are no effective methods of forecasting and combating sudden methane emissions in coal mines yet. There are also no programs to create new scientific foundations for the knowledge and prevention of these phenomena, but the safety of coal mining is needed here and now." In the article, the luminary of mining science named the main unsolved riddles and paradoxes of the scientific problem of sudden emissions of rocks and expressed the discouragement prevailing in the geophysical community and the general tendency of frank confusion due to the lack of noticeable results of many years of research on this problem.

It is not known how long the trampling on the spot and scientific stagnation in the knowledge of the process of sudden emissions of rocks and gas would have continued if chemists and physicists had not come to the aid of geophysicists with the theory of quantization, the concept of a chain chemical reaction and the mechanism of the Coulomb explosion turning into Richtmyer—Meshkov instability, when the impact of force is replaced by a brief and powerful impulse. Finally, nowadays, there has been a qualitative shift in understanding the essence of the physicochemical transformations taking place in the rocks of the rock massif at the micro level, that is, at the level of quanta and atomic particles, which made it

possible to build a real model of the process of sudden release of rocks and gas. So far, however, in general terms, but the contours of this model are clearly outlined, as well as the path along which to move. For mining engineers and geophysicists, a wide field has opened up for new research and experiments, taking into account the new knowledge. But some 2-3 years ago, having received any article about the Coulomb explosion and quantum phenomena in the rocks of the earth's crust and mantle, and about the processes of chain chemical reactions in various minerals, leading to the so-called hydrodynamic phenomena in the rocks massif, the editors of scientific journals would have considered pseudoscientific and sent straight to the trash.

The Theoretical Part

It is known that depending on the type of atomic particles located in the nodes of the crystal lattices, and the nature of the bond between the particles, there are four types of lattices: ionic, atomic, molecular, and metallic.

It is known that the rocks of the earth's crust contain almost no pure substances, i.e. Rocks are a composite of many elements, which means that any rock can contain an ensemble of various types of crystal lattices, randomly located throughout the volume of rocks in the form of mineral inclusions.

It is known that the crystal lattice can explode due to the destruction of bonds between atomic particles in accordance with the mechanism of the Coulomb explosion, which consists in the fact that between the atomic particles located in the nodes of the crystal lattice there are Coulomb repulsive forces, which are compensated by the electrons in the volume of the lattice.

It is known that in the case of the removal of a part of electrons from the lattice volume, the Coulomb destruction of bonds between the particles occurs and the crystal lattices instantly explode with the release of energy.

It is known that the process of a Coulomb explosion takes $\geq 10^{-9}$ s. Consider the classic examples of the Coulomb explosion described in the scientific literature.

Chemical Coulomb Explosion: Until now, the scientific world knew and firmly believed that the explosion of sodium in water occurs due to its active reaction with water, during which a large amount of heat and molecular hydrogen $2Na + 2H_2O = 2NaOH + H_2 \uparrow$ is released, which leads to the formation and explosion oxyhydrogen gas $2H_2 + O_2 = 2H_2O$. And suddenly, in 2015, a group of Czech scientists discovered that this was not true! As scientists have shown during experiments recorded on a high-speed camera, when sodium is immersed in water, there is an immediate exit of electrons from the metal surface [2]. As a result of the process, an electron deficiency arises in the lattices of sodium molecules. As a result, the Coulomb repulsive forces of ions begin to prevail, which leads to the explosion of the lattice with the release of the explosion energy.

Mechanical Coulomb Explosion: In this type of Coulomb explosion, the atoms-ions of the nodes of the crystal lattice are bound by free electrons, which move inside it in a random manner, reminiscent of the movement of an electron gas. It was shown in that if free electrons are "distracted" from the role of "glue" by increasing the energy of the electron flow, this will lead to the escape of electrons from the crystal lattice and its explosion [3]. The increase in the energy of the electron flow can be achieved in several ways:

a) Due to the inertial forces of electrons. A striking example of such a case is the sharp deceleration of a modern high-speed projectile when it hits the armor of a tank and the appearance at this moment of the inertial force of electrons, which continue to move and, due to the inertial forces that have arisen, fly out of the crystal lattice. A Coulomb projectile explosion occurs, the energy of which burns through the tank's armor. The fact that the inertial process of the Coulomb explosion is real was shown by the famous experiment with a coil of copper wire conducted by the American scientists Tolman R. C. and Stewart T. D. back in 1916.

b) Due to the forces of electromagnetic nature, when a high-density electric current is passed through a substance or irradiated with a high energy laser beam. It is known that the current density is proportional to the electron flow velocity, and the kinetic energy is proportional to the square of the velocity. Consequently, if the current density is increased by a factor of a thousand, the kinetic energy of the electron flow will increase by a factor of one million and they will unanimously leave the crystal lattice, which will naturally lead to a Coulomb explosion. At the moment, there are several patents for "Method of the explosion of solid metal using electrical force," for example, RU2145147C1 [4].

Below we will cite several cases of sudden emissions of rocks and gas from the rock massif, from which it can be concluded that nature uses chemical, mechanical and combined mechanisms of the Coulomb explosion in the emission processes. A common feature of chemical and mechanical Coulomb explosions is the release of a by-product. This is the formation of a large amount of ultra-fine grinding dust, the so-called Rabid flour, reaching up to 40% of the total mass of the emission. The sizes of the particles of Rabid flour are within a few nanometers, which can be formed only in a single case - as a result of the destruction of crystal lattices, because such fine grinding of the rock cannot be achieved by any types of blasting, or without special equipment such as ball mills [5]. In the mining literature there are numerous descriptions of the release of Rabid flour during mountain impacts, underground emissions and large landslides. For example, as a result of the collapse that occurred on November 12, 2007 on the northern wall of the Einser in the Sistine Dolomites (Italy), it was documented that the landslide mass and the surrounding area were covered with a layer of Rabid Flour ~ 100 mm thick. The presence of Rabid flour unites all these phenomena and is a strong proof that the processes of mountain impacts, emissions, landslides, volcanic explosions and earthquakes are a single process of Coulomb explosion of rocks.

In our opinion, the formation of significant volumes of gases during the processes of sudden emissions of rocks is also a by-product of

the process, which makes an additional contribution to the energy characteristic of the Coulomb explosion. It should be added that the mandatory presence of a large number of different gases in the process of sudden rock emissions from the very beginning of the study of the phenomenon sent several generations of scientists on the wrong track, because scientists made a big mistake, tempted by the "obvious" role of gas in the process of rock emissions, and scientific inertia elevated the gas factor to the category of taboo, which reads: - When the rock pressure changes, the gas degassing from the rock mass creates excessive pressure in the rock mass and when the rock strength limit is exceeded, a sudden release occurs-an explosion according to the type of explosion of a vessel under pressure. As it turned out, this path led to a dead end, and cheerfully moving along the "gas" road, scientists have delayed solving the problem for more than a hundred years. In fact, everything turned out to be quite different. It turned out that the gas degassed by the rock massif plays an insignificant role in the ejection process, but the bulk of the gas is formed in the massif at the time of the Coulomb explosion and the subsequent chain chemical reaction (CHR). The process of gas formation occurs for two reasons:

1. In chemical reactions by the type of formation of hydrogen molecules in the reaction of sodium in water. For example, due to hydroxide ions in the crystal lattices of hydroxides and basic salts.
2. As a result of dissociation and ionization of molecules of solid solutions of gases formed in the crystal lattices of rocks at the time of the primary formation of the rock massif and gases passing into the free state in the Coulomb explosion hearth due to the resulting CCR. The chain nature of the reaction is caused by the appearance of accelerated electrons, which are not only the source of the Coulomb explosion, but also the initiator of the CCR and which, in turn, will cause the appearance of intermediate active particles (free radicals, excited atoms and molecules) [6-8]. It should be noted that the formation of the gaseous phase and the passage of the shock wave of the Coulomb explosion causes another physical phenomenon in the rock massif, which is especially pronounced during sudden underground emissions - the Richtmyer—Meshkov instability, the result of which is a sudden exodus from the rock massif of turbulent jets of the formed gas and the destroyed rock particles captured by them from the point of origin disturbances following the front of the shock wave passage [9]. This effect also contributes to the energy of the whole process.

Quantum Rock and Gas Ejection Mechanism

During the formation of an elementary rock mass, as a result of the action of high temperatures, pressure, an aggressive environment, and the stresses arising from the movement of rock blocks, metamorphic transformations of the mass occur. Over time, the rock massifs not only change the geological, geometric, and chemical form and structure, but also energy parameters. As a result of the compaction of rocks (a change in its volume), as well as from the effect of high temperatures, energy in the form of quanta is imparted to the electrons of the rocks. According to Mr. Bohr's quant model of the atom, if the energy imparted to the electron exceeds the critical potential, then the electron goes to a higher level, storing potential energy (a macroscopic analogy is a compressed spring). A rock massif in such a metastable state can remain indefinitely. Over the years, at a random moment in time, as a result of the confluence of various natural or man-made factors, there is a sharp decrease in rock pressure in the considered elementary volume of the rock mass. In this case, the rock mass changes its volume and shape in the form of rock heaving (analogy - the spring is unclenched) and as a result, its potential energy sharply decreases, and the kinetic energy, and therefore the speed of electrons, atoms, and molecules, increases sharply, which leads to their mutual inelastic collision of the second kind, the appearance of electric charges and the appearance of an electromagnetic field. In this process, it is especially important that in inelastic collisions of the second kind, electrons do not emit quanta, but on the contrary, energy is transferred from excited atoms and molecules to electrons. As a result, electrons are accelerated and leave the crystal lattice, simultaneously initiating two processes - the Coulomb explosion and the CCR. There are two things to note here:

1. The first nuance is associated with the behavior of hydrated water molecules. In the generated electromagnetic field, the H_2O molecules create a hydration shell around the ions of the crystal lattice, which screens the ions from charges of the opposite sign. And since water, depending on the temperature, has a high dielectric constant of ~ 80, the electrostatic attraction of ions and electrons will accordingly decrease ~ 80 times. It should be noted that many rocks of the lithosphere contain hydroxide mineral impurities containing hydrated water: [(SiO_2, Al_2O_3, TiO_2, Fe_2O_3, CaO, MgO, K_2O, Na_2O) • nH_2O]. For example, the mineral constituent of marble limonite - Fe_2O_3 • nH_2O, is also the mineral constituent of coal and many other rocks. In connection with the leading role of the dielectric constant in the ejection processes, it should be noted the class of so-called ferroelectrics, which can also be part of rocks, for example, the constant of the dielectric constant of tetrahydrate of double sodium-potassium salt $KNaC_4H_4O_6$ $4H_2O$ is much higher than water and is ~ 500.
2. The second nuance lies in the fact that the nucleation of chains occurs with the participation of numerous admixtures-initiators, which are rich in rocks. Such impurities can be molecules with a weak bond, for example, alkali metals, during the decomposition of which free radicals are easily formed, or molecules that easily enter into redox reactions. For example, coal ash, depending on the grade, contains: 1.3 - 80.9% Fe_2O_3; 0.87 - 42.7% Al_2O_3; 1.7 - 76% SiO_2; 0.6 - 36.9% CaO; 0 - 10.7% SO_3. In addition, small amounts of lithium, potassium, sodium, magnesium, rubidium, cesium, sulfur, phosphorus, sometimes titanium, zinc, copper, nickel, etc. are included in the composition of coal, which can act as initiators of the CCR.

Consider a few examples of sudden rock and gas outbursts.

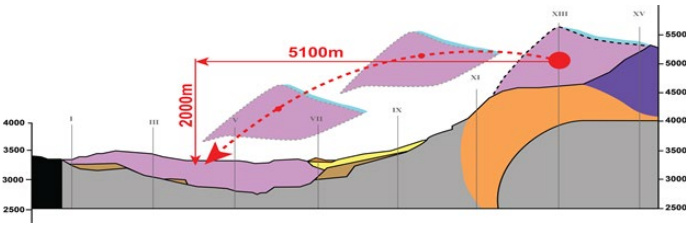

Figure 1: Usoy Landslide [10] page 280

The Usoi collapse that occurred in the Pamir on 02/18/1911., Fig. 1, can be considered a sudden release of rocks and gas, because a block of rock with a volume of ~ 1.5 km³, after being torn away from the parent body, did not just slide down the slope, but flew a distance of 5 km. along an inclined path [10]. The calculated energy and momentum of force for the movement of a physical body of such a mass is 1.1×10^{17} J. To date, there is no reasonable explanation for this well-described and documented case in the scientific literature, however, as well as other similar catastrophic collapses. We believe that the Usoi collapse occurred due to the Coulomb explosion that occurred at the time of a sharp change in the cantilever loads in the mother's body when various natural mining-hydro-geological and weather factors coincided in time. It is known that the displaced mass of the ejection consisted of siliceous shale, and the bed of the ejection funnel was lined with reddish marble. According to our hypothesis, as a result of a combination of various factors, the cantilever loads exceeded the ultimate strength of the rocks in the zone of contact between siliceous shale and marble. A sudden redistribution of loads led to the appearance of accelerated electrons in the array, which, having received energy from excited atoms and molecules and the energy of inertial forces at the moment of acceleration, were forced to leave the crystal lattice. The electromagnetic field induced by the moving stream of electrons unfolded the dipoles of the hydrated water of the marble, which isolated the ions of the crystal lattice and compensated for the Coulomb forces of attraction between the ions and electrons by the value of the constant of dielectric permeability, which gave rise to the reactions of the Coulomb explosion and CCR. The resulting impulse of force with an energy of $1.1 \bullet 10^{17}$ J. threw a part of the mountain range with a volume of 1.5 km³ at a distance of 5 km. The resulting gases scattered in the atmosphere. The collapse zone was covered with a layer of rabid flour, the deposits of which can be traced to the present day. In addition, the researchers found melted pieces of rocks, which in no way fit into the gravitational hypothesis of collapse. Our hypothesis assumes that the fused rocks serve as strong evidence of the high-speed process of the Coulomb explosion that occurred, accompanied by the release of a significant level of thermal energy, which the massif did not have time to take away and that served as an impetus for further heating of rocks and gases in geometric progression and for the even greater acceleration of reactions due to shock ionization. On September 2020 a similar incident occurred in the vicinity of Toronto, Canada, when the Scarborough Bluff collapse and was accompanied by the sound of a strong explosion and a thick cloud of rabid flour [11]. True, the caliber of this emission was much smaller.

Sudden Rock and Gas Outbursts in Underground Potash and Coal Mines

From the experience of underground mines for the extraction of potash salts and coal, it can be concluded that the amount of rock and gas emissions increases with the depth of mining, that is, with an increase in rock pressure. Sudden emissions pose a huge threat to people's lives. Only in the mines of Ukraine during the period from 1951 to 2005 years 7230 sudden emissions occurred, and in the period from 1971 to 1980 years 259 miners died. The most powerful underground release of rocks is considered to be the release of 14 thousand tons of coal and about 600,000 m3 of CH4 gas, which occurred in 1969 in Ukraine. The mine tunnel was covered with discarded coal for 650 m. The release of methane gas at a Chinese mine is known, which amounted to an astronomical figure - a million cubic meters in a few seconds! It should be understood that high-pressure methane production wells produce such an amount of gas only per day of operation.

Let us give an example of a classic discharge that occurred on June 7, 1953, at the Menzengraben mine (Germany). At the time of the release, several hundred thousand cubic meters of gas were released and about 100,000 tons of salt were emitted. The gas mixture consisted of CO_2 (up to 95%) and N_2. Gas escaped noisily from both shaft shafts 520 m. deep for about 25 minutes. The blowout completely disrupted ventilation, destroyed the mining equipment, the reinforced concrete roof of the mine shaft [12]. Based on the consideration of the conditions of the Coulomb explosion, we can conclude that the mined potassium salt - carnallite $KCl \bullet MgCl_2 \bullet 6H_2O$, ideally meets the requirements of the initiator of the Coulomb explosion and CCR. Carnallite is an aqueous potassium chloride, which is no less aggressive metal than sodium, which has hydrated water molecules in its composition. In addition, the mineral carnallite includes impurities of other, no less aggressive alkali metals - rubidium and cesium, which, in turn, can act not only as initiators of the Coulomb explosion but also as catalysts for CCR. And the last, no less important point, a sudden release occurred at the time of blasting, that is, at the time of a sharp drop in rock pressure in the massif. In this case, an ideal case of a merger of chemical and physical and mechanical factors occurred, which led to a powerful ejection of rocks from the massif, which ended in a gas ejection as a result of the Richtmyer-Meshkov instability. According to the same scheme, sudden rock and gas outbursts occur in coal mines, but since coal contains much less alkali metal impurities in its composition, the process of coal sudden rock and gas outbursts is extended over time. Initially, several local mini-Coulomb explosions occur, which accompany the CCR of insignificant strength. In the process of "swinging," more and more atoms and electrons are drawn into the ejection process. In the rock mass, noise effects, increased gas release, firing of the rock with pieces of coal, peeling of the face and sides of the mine start, and only after such “swinging” a full-fledged release of rocks and gas occurs. Although, sudden rock and gas outbursts of significant strength can occur immediately, without “swinging”.

Volcanic Explosions

Humanity has experienced another disasters associated with the movement of rock masses, these are explosions of volcanoes, which sometimes reached significant values. For example, during the eruption of the Krakatoa volcano in 1883, the energy released during the explosion amounted to a monstrous figure - 200 Megatons of TNT. If we consider the explosion of a volcano from the position of moving significant masses of rock, then we can attribute this phenomenon to the process of sudden release of rocks and gases. This means that we have the right to consider volcanic explosions from the position of a Coulomb explosion. Famous volcanologist, academician N.L. Dobretsov cited data on the mineral composition of the rocks of the Tolbachesky volcano, which indicate a high content of alkali metals in the rocks composing the construction of the volcano [13]. If we add to this the presence of hydrate water molecules in the rocks, high temperature and frequent movements of the rocks of the base of the volcano and its cone as a result of a swarm of hydraulic shocks during the movement of magma flows in magma chambers and channels, then an ideal picture is formed for the implementation of a Coulomb explosion [14]. Moreover, we claim that earthquakes occur under the same scenario, since the rocks of tectonic plates contain oxides and mineral impurities of alkali metals and hydrate water, and high variable loads of tectonic plates at high rock temperatures contribute to the involvement of large volumes of material in the process, which leads to the release of a huge amount of seismic energy. In some cases, the Coulomb explosion proceeds as a classical swelling of the rock massif, followed by acceleration of the process, turning into an avalanche flow and explosion. For example, the well studied explosion of the volcano St. Helens on May 18, 1980. After 123 years of hibernation, the volcano woke up, and the rocks of the northern slope of the volcano began to heave intensively at a rate of up to 2 meters per day. In April and May, the heaving was 200 meters. Then, on May 18, there was an explosion of heaving rocks with an emission of ~ 2.7 km3 rock mass, with a TNT equivalent of an explosion of ~ 2.5-3.5 Mt.

Conclusion

Based on the above material, we can conclude:

1. The source of sudden rock and gas emissions is the Coulomb explosion of crystal lattices of rocks and a chain chemical reaction.
2. A sudden change in rock pressure in the massif and chemically active substances such as alkali metals can easily initiate a Coulomb explosion.
3. The appearance of accelerated electrons in matter gives rise to the processes of Coulomb explosion and CCR.
4. The presence of hydrate water molecules and mineral constituents of rocks catalyzes the processes of Coulomb explosion and CCR.

The ordinariness of the Coulomb explosion process, convincingly demonstrated in the reaction of sodium in water, destroyed the myth of the Coulomb explosion as a process capable of proceeding only at high energy costs and parameters, at high P, T and only in special cases, allegedly unattainable under normal conditions of substance existence. Based on the above examples, we have shown the possibility of a Coulomb explosion in the rocks of the Earth's crust and assert that all the movements of the Earth's crust: sudden emissions of rocks and gases, mountain impacts, catastrophic collapses, volcanic explosions and earthquakes occur according to the same scenario with minor nuances depending on mining and geological conditions.

References

1. Mason, P. E., Uhlig, F., Vaněk, V., Buttersack, T., Bauereckker, S., & Jungwirth, P. (2015). Coulomb explosion during the early stages of the reaction of alkali metals with water. Nature chemistry, 7(3), 250-254.
2. Marakhtanov, M., Marakhtanov A. (2002). Coulomb explosion of metal. The scientific journal Science and Life.
3. Yavorsky, V.V. (1988). Energy from nowhere. The scientific journal Science and Life.
4. Marakhtanov, M. K., Marakhtanov A. M. (2000). Method for Removing Communication Energy from Electrically Conductive Materials. Patent for invention RU2145147C1.
5. Bulat A.F. Dyrda V.I. Sudden emissions coal and gas in the context nonlinear nonequilibrium thermodynamics. Scientific journal Coal of Ukraine. December 2013.
6. https://xumuk.ru/encyklopedia/2/5139.html.
7. Bychkov, S. V. (2016). Chemical reactions during earthquakes. An explosion of the rock mass as a source of tremors, sudden emissions, and rock bursts. Bulletin of the Scientific Center for the Safety of Work in the Coal Industry, (4), 38-47.
8. Semenov, N. N. (1956). Some problems relating to chain reactions and to the theory of combustion. Nobel Lecture, 487-514.
9. Ortega, A. L., Lombardini, M., Barton, P. T., Pullin, D. I., & Meiron, D. I. (2013, July). Richtmyer-Meshkov Instability at Solid-Gas Interfaces. In International Symposium on Shock Waves (pp. 1131-1136). Springer, Cham.
10. Vaskov I.M. (2019). Large-scale landslides: geodynamics and forecast. Vladikavkaz, 365.
11. https://www.cbc.ca/news/canada/toronto/large-portion-scarborough-bluffs-collapse-1.5697143.
12. Laptev, B. V. (2011). Historiography of development accidents salt deposits. Scientific journal Labor Safety in Industry, 12.
13. Dobretsov N.L. (2018). Volcano Tolbachik - a Geochemical Phenomenon. Science first-hand journal.
14. Bychkov S.V. (2019). Earthquake energy and the laws of hydrodynamics. Bulletin of the Scientific Center for the Safety of Work in the Coal Industry.