

ABOUT THE ECOGEOPHYSICAL RISKS AND RESEARCH ON THE IMMERSSED MUD VOLCANOES**H.O.Valiyev¹, R.B.Muradov¹, M.K.Mammadova¹, J.K. Mammadov¹**

ABSTRACT. There are numerous known and immersed mud volcanoes in the Azerbaijani areas of the Caspian Sea. In the article was noted the increase in the number of accidents happened at wells during the exploration of oil and gas fields is directly related to immersed mud volcanoes. While volcanic activity in Azerbaijan is widely studied, almost no research has been carried out to study the immersed mud volcanoes.

In many cases accidents happen in the wells according to geodynamic changes that occur in the mud volcanoes fields as of place and time are not routinely studied up to now. In addition there are different problems in the seismic data acquisition and analysis, the determination of speed parameters. To eliminate situations like this, it is important to take into account the risk of natural hazards in the implemented projects.

Mainly it is recommended to consider the results of seismic research to ensure a normal, safe working mode of the technological processes in the exploitation and processed oil fields.

Key words: mud volcanoes, eco-geophysics, erosion products, composition of fluids, geodynamic tension, seismic recording.

Natural disasters (earthquakes, landslides, volcanoes, streams and etc.) that are not subject to human intelligence greatly damage the state economy and population by creating the extreme situations. Although it is not possible to prevent emergency situations, it is possible to achieve the reduction of consequences by taking the preventive measures.

There are many known and immersed mud volcanoes in Azerbaijan territory of the Caspian depression [2]. The study of destructive eco-geophysical consequences of mud volcanoes is one of the most pressing problems.

In many cases, it has been proven that recently the increase in the number of accidents in the wells during the exploration and exploitation of oil and gas fields is connected with the anomalous changes of geodynamic tension occurred directly in the zone of mud volcanoes.

The earthquakes, volcanic eruptions, streams, and floods can be examples of the factors that influence the environment. Problems in that area which are related to each other consist of two parts: a) studying of natural phenomena before the occurrence; b) taking the preventive measures and minimizing possible damages. The difficulty is that many of the natural phenomena are unexpected. They are related to the emergency dynamic processes that suddenly occur in nature.

The study of mud volcanoes which bring the actual examples from the deep layers of Earth, which cause ecological consequences and which is a beautiful natural monument, is one of the most pressing problems. So far, although the volcanic activity in Azerbaijan has been widely studied, almost no research has been done in the direction of studying immersed mud volcanoes.

During the mud volcanoes activity residential and farming areas near it, the transport-road junctions and etc. are in dangerous emergency situation and it is necessary to take some security measures. Besides all this, another problem is related to the research and exploitation works in the fields covered by mud volcanoes. As we know, there are mud volcanoes in the most of the oil-gas anticline type structures and in the most of oil and gas fields related to them.

Mud volcanoes create geodynamic-tension conditions in the oil field and when the collected potential voltage energy is reached to anomalous level the danger is expected every moment. So far, as of place and time the occurred geodynamic changes in the fields with mud volcanoes for not being

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studied regularly, accidents occur in the drilling wells in many cases. In addition, the difficult problems are identified in the seismic data acquisition and determination of speed parameters. The projects implemented to eliminate such cases have shown that it is important to take into account the risk of natural hazardous events.

Mud volcanoes are unique areas that create geodynamic-tectonic tension in a certain area on the ground. There are over 2,000 known mud volcanoes in 26 countries of the world (Columbia, Italy, Romania, Russia, Ukraine, Pakistan, etc.). There are 350 mud volcanoes and volcanic manifestations in dry areas of Azerbaijan (Fig. 1) and in the Caspian Sea [2]. These are located on the Absheron peninsula, Gobustan, in the south-eastern Shirvan plain, on the Samur-Devechi lowland, Absheron and Baku archipelagoes. The largest of them is Galmas, Toragay, Great Kenizdagh and others. The most of their structure is in the cut cone form. The height is 20-400m; the diameter of the coverage area is 100-4500 m.

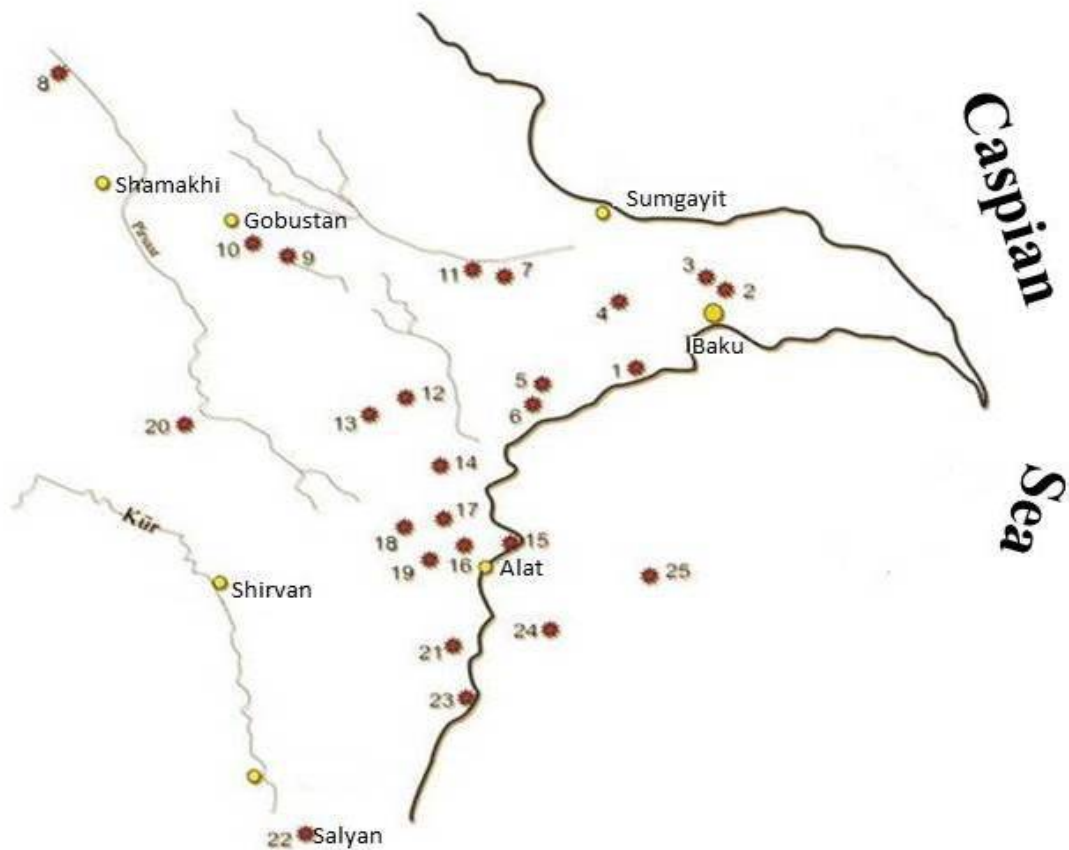


Figure 1. The map of mud volcanoes in Azerbaijan

During the eruption, mud emerges to the surface along with hydrocarbon gases (Fig.2), there occurs a 300-400 meters flame column (Fig.3), sometimes high percentage of carbon dioxide and at the same time the large amount volcano breccias emerge. During the quiet activity of the volcano again gas, mineralized water, slimy mud and in some volcanoes are extracted much oil and as a result, unusual saline soil and geochemical rare landscapes emerge in the volcano area and have an impact on the environment. The proximal and gryphon-salsa activity of widespread mud volcanoes in Azerbaijan forms rare landscapes, affects the environment and living organisms. The high concentration of chemical elements or lack of sufficient quantities, their unusual proportion for the biosphere cause certain changes in the status of an ecosystem in the mud volcanoes zones.

One of the key issues is that the mud volcanoes areas are polluted and people settle down near the volcano. After the eruption of the Keyreki mud volcano near Binagadi settlement in February 2002, a largely residential area was built near the volcano and some buildings were built on the slopes of the volcano [2].

In addition to the mud volcanoes on the land, immersed and sea mud volcanoes are also known. There are more than 140 underwater mud volcanoes in the Caspian Sea. The eight islands (Khazar-Zira, Zambil, Garasu, Gil, Sangi-Mugan, Chigmil and others) on the Baku archipelago are of mud volcano origin. The embedded mud volcanoes were found in the wells. The traces of their activity are found between various old layers. According to the data, the first activity of the mud volcanoes in the territory of Azerbaijan Republic is about 25 million years ago. Usually, mud volcano eruption begins with strong underground roaring and explosions. Gases emerged to the surface from the deep layer of the Earth flare up. Sometimes it was observed that the height of flame reached 1000 m (Garasu volcano) on the volcano. From 1810 up to now, 50 volcanoes have erupted nearly 200 times in the territory of Azerbaijan Republic. 19 eruptions were recorded in Lokbatan volcano. The mud volcanoes erupt solid, gas, and liquid. There are 100 times more mineral and up to 30 microelements (boron, mercury, manganese, copper, barium, strontium, lithium, etc.) in solid products. The mud volcanoes are related to the oil and gas fields. The rich oil and gas condensate deposits were discovered in the mud volcanoes areas (Lokbatan, Neft Dashlari, Garadagh, Mishovdagh and others). Their mud is a valuable raw material that used for the treatment. In 2007, the "State Nature Reserve of the Mud Volcanoes range of Baku and Absheron Peninsula" was created and 52 mud volcanoes had been given the status of state natural reserve.

It should be noted that the volcanic eruptions are one of the fascinating phenomena of nature, but also are dangerous to humans. Volcanic eruption can not only cause scattering and dissemination of mud volcano materials, as well as the contact of air and soil with other unwanted potential pollutants. On the other hand, the activity of mud volcanoes leads to the creation of a landscape that is accompanied by special type of salinization. The last one is sometimes absorbed by oil.

It is known that 40 volcanoes and volcanic manifestations in Azerbaijan produce much oil. Their positive or negative effect to the characteristic of the geochemical landscape, the volcanic rocks, and composition of fluids, microelements-boron, molybdenum, lead and etc. are determined by the anomalous amount in the new mudflow.

To assess the impact of mud volcanoes on the environment, different morphological content and activity of the volcanoes should be taken into account, as well as a comparative analysis of the number of microelements in the volcano breccias, soil, the ash of animals and plants must be fulfilled. (Fig. 2).

When the mud volcanoes are active, it is known that there are dangerous consequences. If there are residential areas, farming areas, the road-traffic junctions near the volcanoes and etc. it is important always to take into account the likelihood of having dangerous emergency situations and to take appropriate actions.

The main natural elements and compounds that pollute the atmosphere are thrown into the air in the form of nitrogen oxide, carbon dioxide, methane and other hydrocarbons, radon, radioactive elements and heavy metals (As, Cd, Cr, Pb, Mn, Hg, Ni, V), solid aerosols not only through ordinary volcanoes, as well as mud volcanoes. (Fig. 3).

Bozdagh-Guzdek volcano which erupted in 1902 led to the death of 6 people and 2,000 sheep. Also, the land splitting is related to the crater area of the volcano. Its effects cover the pressing of soil through cracks, mixes or collapses and around throat of earthquake faults. The mudflows can be 100 m wide and 1m thick. Furthermore, the soil sedimentation zones or displacement of the soil along cracks and faults can be extended to the studied areas from volcano throat.

So far, as of place and time the geodynamic changes in the mud volcanoes fields for not studying regularly, there have been accidents in the drilled wells in most cases. The causes of accidents were not often investigated and are shown either as a geological or technical reason. For



Figure 2. Durovdagh mud volcano, hydrocarbon gases emerge to the surface with mud.



Figure 3. Otman – Bozdagh 08.02.2017, 14:23

example, a terrible accident has occurred at the well 42 which drilled in the Dashgil volcano area on Baku archipelago. The 2500 m long steel pipes were thrown out of the well and became spiral. Then the mud flow had started from there.

In Indonesia, there was the more terrible event [3], an accident occurred during the digging of the gas well and the mud fountain from the well had covered the ground (Fig. 4). As a result, there were human casualties, the mud covered lots of residential areas and the material damage was great.



Figure 4. The situation created by the mud eruption during the drilling of gas well in Indonesia..

As it was mentioned above when the mud volcano is active, the damage to residential areas and other facilities is great; the exploitation regime is violated in the oil field. The dangerous effects of mud volcanoes include the volcanic breccias streams, collapses, faults and shifts of layers, manifestations of gases, burning of gases and formation of anomalous high-pressure zones.

In addition, there are difficult problems in determining speed parameters in seismic data acquisition and analysis:

- Since there is no reflective border within the cone of mud volcanoes a complex, chaotic seismic recording view is observed;

- Since going through from the wing of structure to the arch in section the follow of seismic horizon becomes difficult and etc.

Besides all this, the most pressing issue is related to the research and exploitation works in the oil fields covered by mud volcanoes. It is known that there is mud volcano mainly in most of oil-gas anticline type structures and oil-gas fields related to them. (Fig. 4). The mud volcanoes cause geodynamic tension in the oil-gas field and it is expected to be at risk every moment when the potential tension energy reaches the anomalous level (Fig. 5).

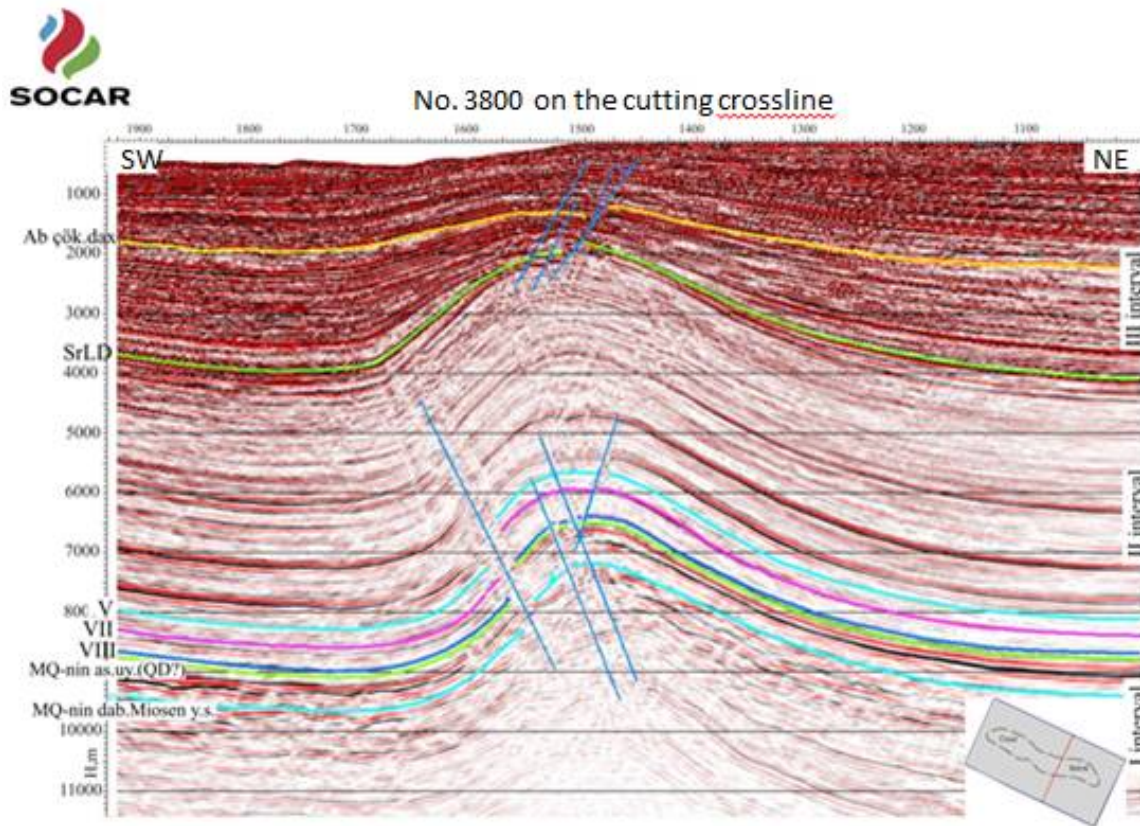


Figure 4. The description of mud volcano in 3D seismic section conducted on Umid-Babek area, Baku archipelago

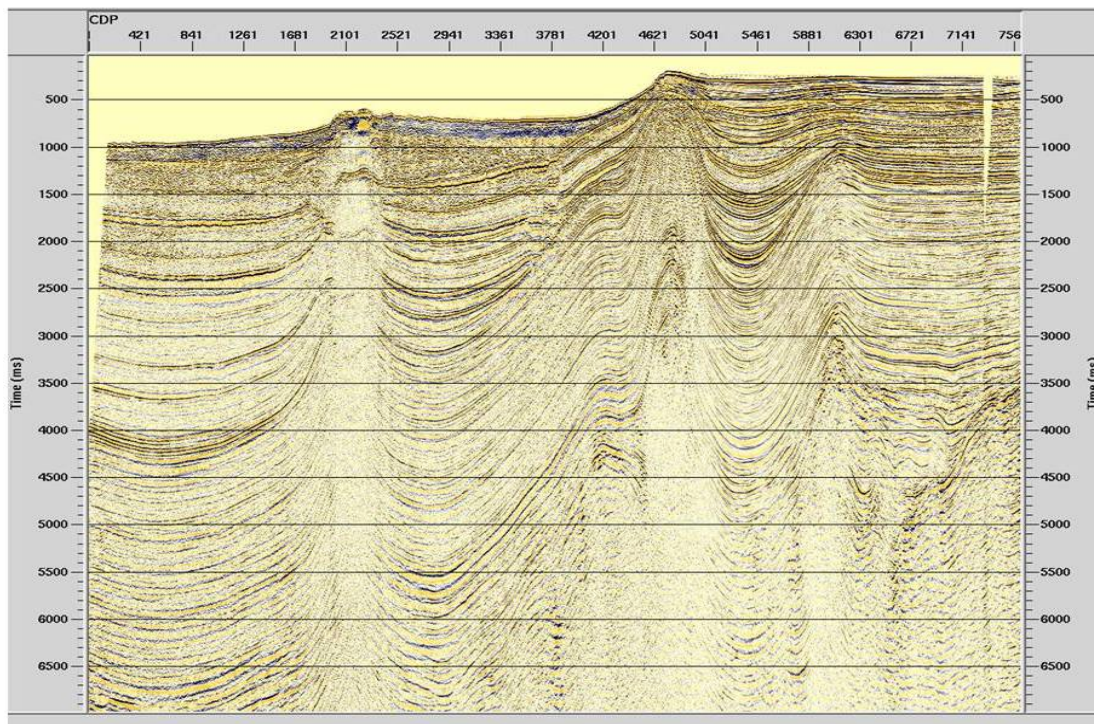


Figure 5. Description of the mud volcano in the migration section in Absheron structure

To solve these problems correctly, mud volcanoes should be regularly studied by modern geophysical methods and devices. The research should be carried out by taking into account that the parameters of the seismic wave which pass through the mud volcano have changed according to the geodynamic tension condition in the environment. For this purpose, studying the work mentioned in the original variant, to study the likelihood of immersed mud volcanoes in the fields modern two-dimensional (2D) and three-dimensional (3D) seismic surveys are proposed:

1. To create a monitoring station within the 3 volcanoes surround that is in the operation and temporarily suspended, regularly monitoring changes in geophysical fields mainly speed parameters with satellite-related software devices.
2. To transmit the results of the research to a center operatively and determine the anomalous condition of geodynamic tension in the region, to determine the likely occurrence of events and take immediate security measures
3. To conduct a normal, safe working mode of technological processes by taking into account the monitoring results in the oil fields which is prepared for processing and operated and identify the risk.

Thus, the risk of natural hazardous events in the projects which are implemented in the oil fields surrounded by mud volcanoes should be mainly considered according to the results of the seismic research. At the same time, it is possible to estimate the riskiness (the impacts on oil and gas wells drilling and exploitation and environment) of the mud volcanoes by setting their eruption circulation (frequency) and to show the ways to minimize the negative impacts.

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