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*Industrial Engineering
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conference

PROCEEDINGS

**IX International Conference –
Industrial Engineering And Environmental
Protection (IIZS 2019)**

Zrenjanin, 3rd-4th October 2019.



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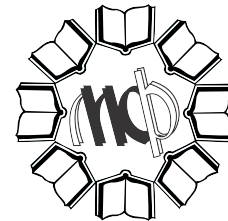
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SPECIAL METHOD FOR INVESTIGATION OF GEOCHEMICAL PARAMETERS IN STUDIES OF ENVIRONMENTAL PROTECTION, HYDROLOGICAL AND MINERALOGICAL STUDIES

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Abstract: For a long time, seismic exploration deposits have been particularly related to areas distant from urban environment, from settlements, traffic arteries and objects of specific purpose. Nowadays, predominantly speaking about Europe, seismic exploration is successfully performed in towns and villages, as well near to important traffic arteries. Modern technical devices, as modern technology of 2D and 3D seismics on land or water, but also necessary measures of caution, are the guarantee that reliable seismic section could be obtained after seismic data processing related to half-space under settlements, airports, roads, railroads and objects of specific purpose.

Keywords: geology, seismics, acquisition, exploration

INTRODUCTION

Seismic tests are often mentioned for its use in oil industry, and that is when seismic section is referred to in scientific circles. Seismic section is just one of the final results of a long and complex procedure of seismic tests, which hides a very demanding technical and technological process starting from seismic acquisition, via seismic processing to seismic interpretation. Seismic acquisition is therefore selected as the basis for all further manipulation of registered seismic records. Further steps in manipulation of seismic signal, which is the core of each seismogeological interpretation, depend on the proper use of seismic acquisition. Seismic tests are being performed in various conditions: in deserts and in many of the world's capital cities.

In order to carry out the seismic tests under safe conditions that are in accordance with clearly specified ecological demands, it is necessary to apply adequate ecological and technical and technological steps of specialised seismic acquisition while operating in areas with distinct elements of urban areas. This requires a good knowledge of seismic testing methodology and environmental protection as well as keeping up with ever-changing trends in science and technology and having experience with the research in various geological and ecological areas [1-4].

BASIS OF SEISMIC REFLECTIVE RESEARCH

Methodology of seismic reflective research refers to the CMP method and the method of multiple seismic overlaying. 2D, 3D and »n«D seismic research could also be conducted, on land and in water. The most common sources of seismic waves used in seismic researches on land are: explosive in a manshaft or on the surface, vibrations and blasts. Obtaining an adequate sub-surface overlay is of great importance while using the equal level of energy, which represents one of requirements to obtain a high quality image of the research area.

In picture No1 we can see the geometry of seismic research done on land and in the sea. The images are sufficiently illustrative and they show how important the geometry of seismic research is, when defining the research area. The geometry is defined with the position of seismic lines determined by the layout of receivers and transmitters of seismic energy [5-7].

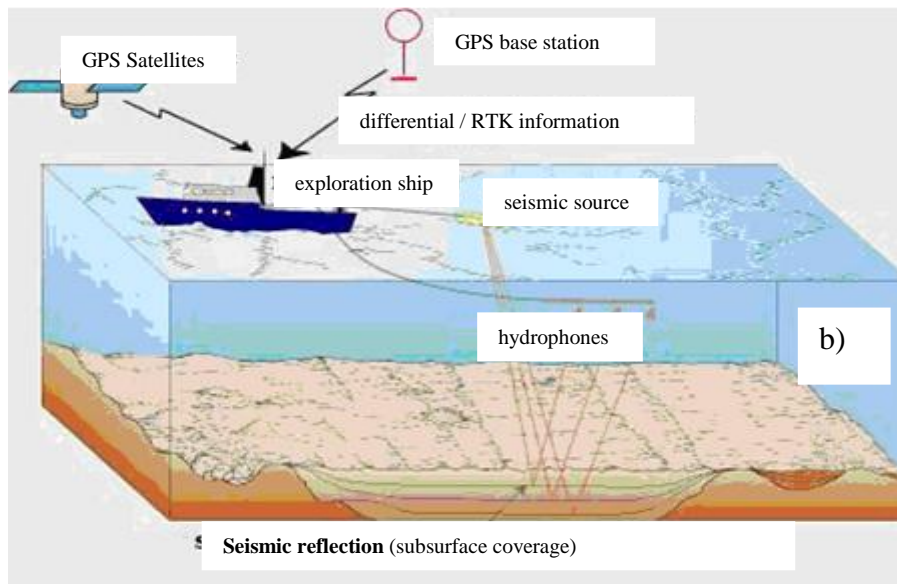
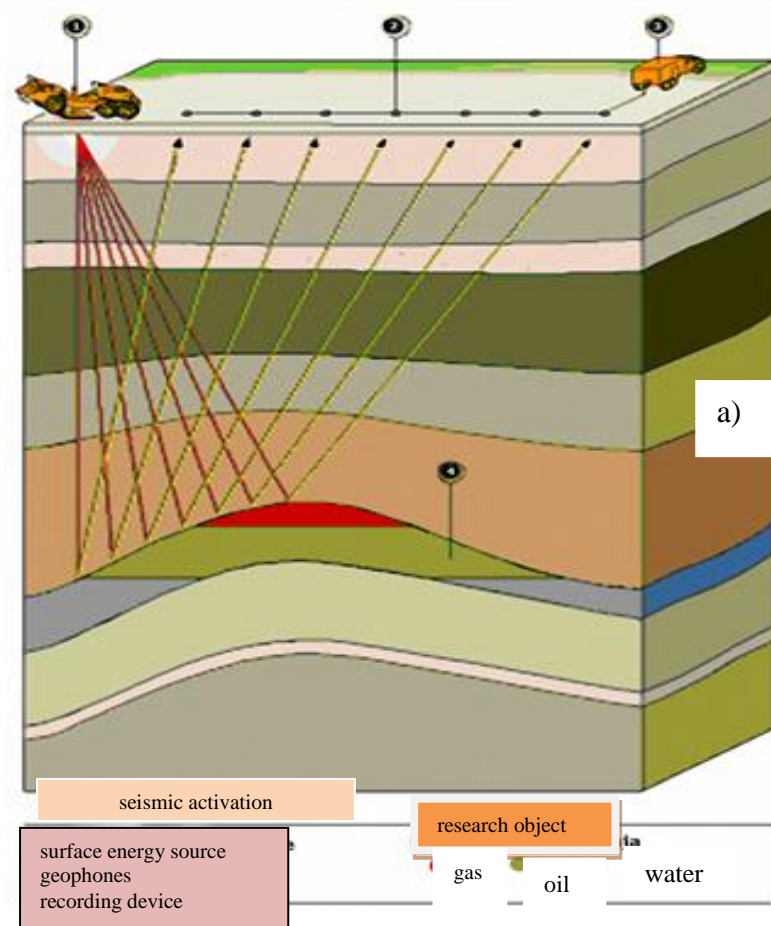


Figure 1. Geometry of seismic research on land (a) and in water (b).

In picture No 2, we can see the scheme and image of seismic reflective research, whose final goal is obtaining the high quality record of seismic waves and clear perception of reflection boundaries that is shown in the seismogram [8-10].

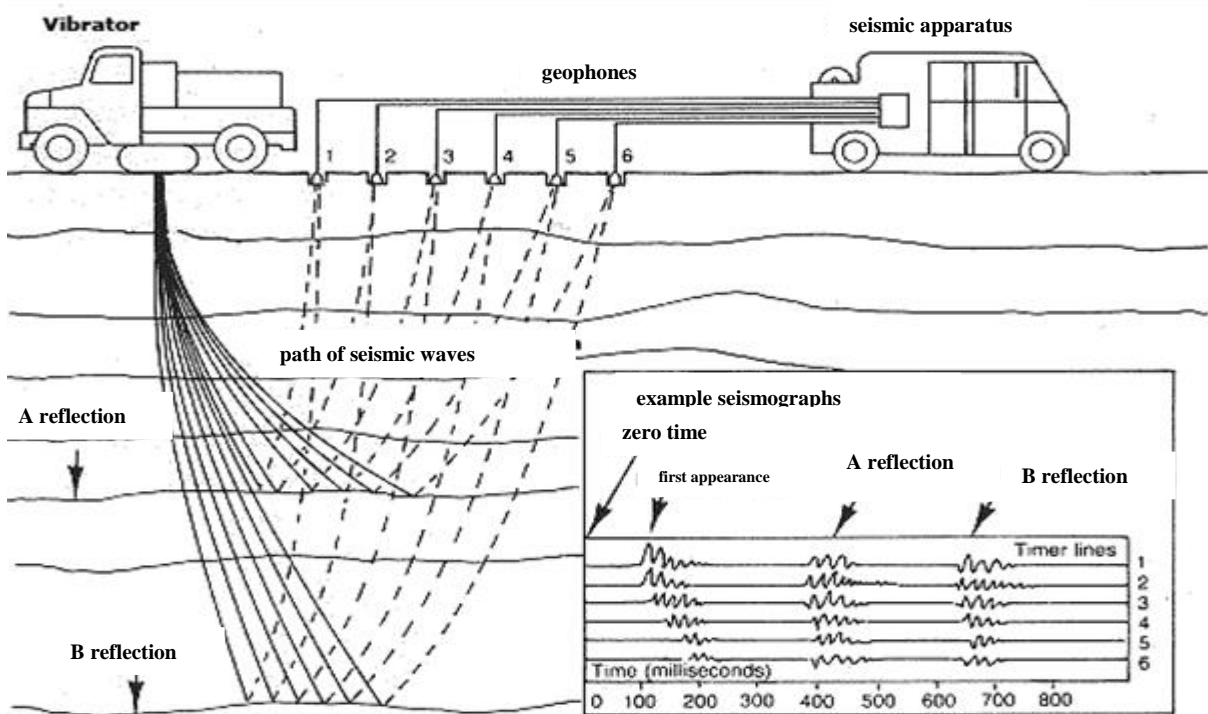


Figure 2. Schematic presentation of 2D seismic reflective research

PROBLEMS WITH THE PERFORMANCE OF SEISMIC ACQUISITION WITH THE AIM OF PROTECTING THE ENVIRONMENT

Seismic reflection tests have been performed in non-urban areas for years, very often in inaccessible areas. The accompanying problems were inaccessibility of measuring points, the safety of workmen and equipment as well as the removal of spatial barriers.

Seismatic tests, done in marine and terrestrial environments, were accompanied by different types of problems, such as different weather conditions, sea waves, navigation, sea currents etc.

As we approached research areas with higher population density, problems with test performance have gained in importance [11-13]. These problems that might arise in urban areas could be classified into the following categories:

- Technical problems, related to the sources of seismic waves and perception line as well as seismic energy receivers,
- Problems related to the quality of seismic signals,
- Problems related to workmen's and equipment's safety,
- Problems related to the protection of facilities,
- Ecological problems.

MEANS OF OVERCOMING THE PROBLEM OF SEISMIC RESEARCH PERFORMANCE WITH THE AIM OF PROTECTING THE ENVIRONMENT

Adequate precaution measures are being taken, depending on the type of problem that might arise during the seismic testing in various areas: urban areas, industrial zones with a high level of activity, areas of special importance etc.

Different companies that carry out seismic tests deal with this problem in accordance with the permission they were granted and their technical and technological capacities as well as the budget money they have to set aside for the removal of damages, damage prevention and gathering the information. This money is also necessary to obtain high quality seismic signals under unfavourable conditions.

Technical problems related to the source of seismic waves and their reception are being removed in the research area, while obeying the all the rules and regulations. It is necessary to implement all the regulations in the most economical way. In the case of seismic energy sources, this could be done in the following manner by:

- Using the approved quantity of explosive;
- Drilling deeper shafts (10 metres and higher);
- Having less number of shafts in »source figure of seismic waves«;
- Having less number of vibrations and less vibration energy;
- Preliminary processing in REC, which eliminates the disruptions and raises the level of useful signal;
- Transferring the receivers of seismic waves, i.e. reception line and emitting seismic energy from the source that is at a safe distance;
- Replacing the types of seismic energy (an offensive with a less offensive one),
- Interpolation or extrapolation of data in REC or in the phase of preliminary processing in the research area;
- Interpolation or extrapolation of data in the course of seismic interpretation.

Problems with setting the receivers and reception line seldom appear. However, they are accompanied by other issues. If it is being set in the city with artificial surfaces, high noise levels and spatial barriers, we need to remove all the obstacles either during the data recording or data processing. This problem could be solved by:

- Stopping the traffic flow, if possible, or working when the roads are empty of traffic;
- Stopping the flow of people and animals and eliminating the influence of noise;
- Eliminating all the obstacles while recording; e.g. elimination of electricity influence (50 Hz in Europe or 60 Hz in USA);

- Eliminating the disruptions in REC in the research area in seismic apparatus or during the phase of preliminary processing;
- If the disruptions remain during the processing and interpretation, we need to file them with the research data, which follow all the technological phases of acquisition.

If we cannot solve this problem in an adequate way, we need to apply the seismic line that follows the surface that is suitable for carrying out tests. That is the so called »slalom or zig-zag line«. Apart from this line, we can use other types of seismic lines, such as parallel lines, adjusted to the conditions of terrain selected for observation.

Workmen`s safety problems are being handled by taking certain precaution measures, set by the law. In nearly all the countries, the implementation of these measures is defined by the law. In order to work without disruptions and obtain a high quality seismic record, we need to obey the regulations and use all the available technical and technological advances of seismic apparatuses [14,15].

Facilities` safety problems that might appear are handled by:

1. Respecting the regulations set by the law and the codex of professional conduct in the observation area;
2. Registering the influence of seismic waves sources in the case of vibrations or explosive;
3. Providing the support of engineering geophysics team that registers and evaluates the influence of seismic movements of different origins.

Requests imposed by the contemporary technology as well as the new way of living are often very harsh. Therefore, industrial complexes are often built in areas with natural or man-made monuments that represent a blend of beauty and usefulness.

Geological activities are not destructive and they are close to the ecological principles and the Nature-Man-Civilisation relation.

Artificial earthquakes that seismics utilizes are harmless to the surrounding environment. The moment they cross the safety boundaries, we need to take measures that will enable the safety of all participants in the seismic testing and at the same time provide a high quality seismic record. Having analysed these records we can find valuable fluids, oil and gas now and water in the future.

There are a number of instances of seismic tests in urban areas. In Europe, seismic lines went through the centre of big cities and traffic and industrial networks. Seismic tests were carefully conducted so that cultural heritage of these cities was not damaged.

Many times, teams that performed seismic tests conducted their lines through inhabited areas and in the vicinity of cultural monuments and caused no harm to the surrounding environment.

During the seismic research, we often use seismic reflection method, and for the source of seismic waves we use vibrators, such as the one shown in picture No2.

Depending on the nature of the research task and the conditions dictated by the urban area used for seismic tests, we can use a different number of vibrators per source of seismic waves.

Vibrators` performance is controlled by geophysicists, whose responsibility is to supervise seismic vibrations caused by the motion and operation of vibrators.

With all the modern equipment that registers vibrations in the above mentioned situations and the equipment for measuring the effects of mining, when the source for seismic waves was the explosive located on the surface, we successfully recorded all the negative effects that could be initiated by the artificial source of seismic waves.

Most world companies that perform seismic acquisition tend to inform the inhabitants in the research area that seismic tests will be done. If the company causes any damage, the inhabitants will be indemnified against any loss. However, when we perform observations in urban areas, we tend to minimize the possible damages.

Sometimes it is necessary to remove certain »obstacles« during the research and then return them to their initial position when the research is over. Reconstruction is being done by the reconstruction specialists depending on the type of so called obstacles; it could be a historical monument or horticulture. Therefore, the use of GPS orientation equipment is of paramount importance nowadays.

The law defines ecological requirements that need to be fulfilled when performing tests. During the seismic tests, we conform to all the above mentioned requirements thanks to the highly sophisticated seismic tests that use advanced technology to register seismic signals. From an ecological point of view, an important part of seismic testing represents an adequate and purposeful use of recording geometry. In picture 3, we can see a 3D scheme of seismic tests performed in the area with high ecological standards.

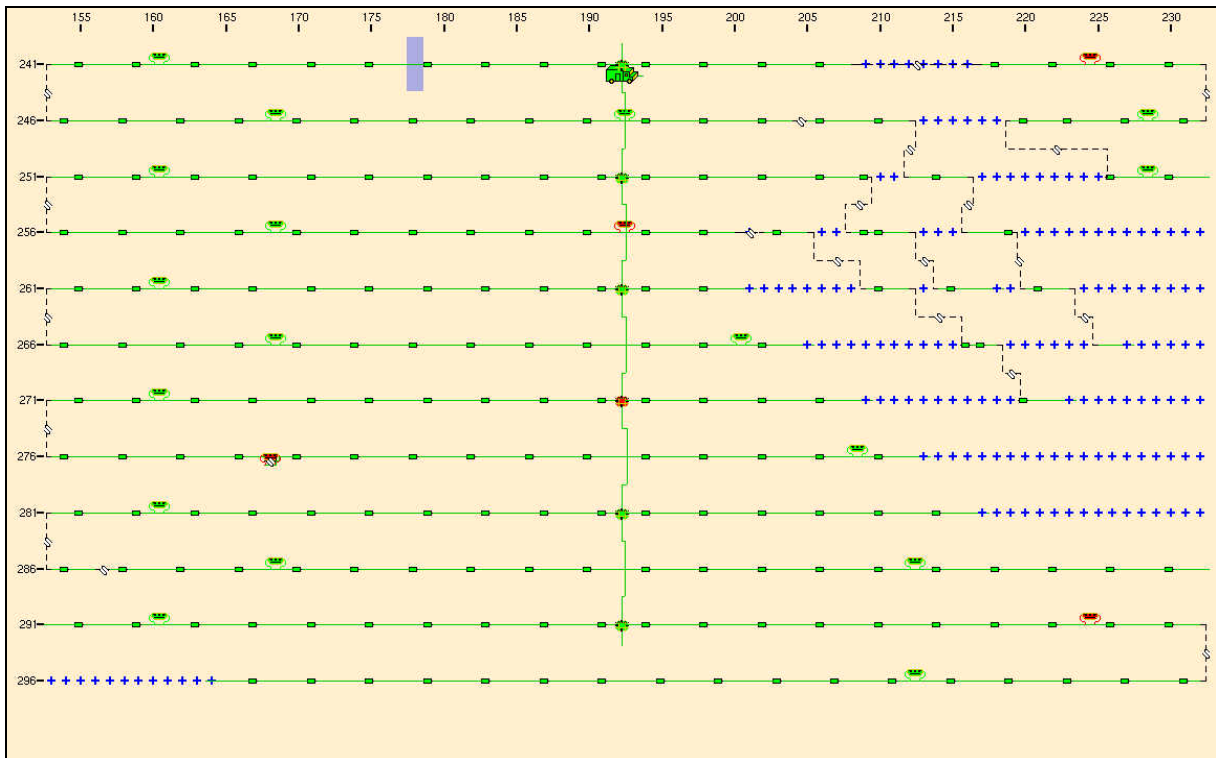


Figure 3. Seismic line under complex conditions in the research area

CONCLUSION

Nowadays, seismic research as well as any type of human activity has to meet the high ecological standards. All the problems that might accompany the performance of seismic tests could be successfully solved if:

- we continually keep up with technical and technological advancements related to seismic research,
- we hire competent and responsible researchers,
- we prepare research thesis in advance while adhering to all the rules and regulations,
- we provide continual and rigorous supervision of data quality as well as ecological conditions

This piece of work is a compilation of several thesis from the domain of seismic acquisition and authors` experience. It has been written in popular style in order to introduce a broad spectrum of people with seismic research and ecological requirements. Our goal is to obtain a high quality seismic record while respecting all the environmental laws and regulations.

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