PROCEDURES FOR DETERMINING THE SURFACE ZONE PARAMETERS AND THE BOUNDARY IN THE SUBSURFACE USED IN SEISMIC PROSPECTING

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Abstract: In the paper we present the methodology of establishing the boundary parameters in the boundary parameters in the subsurface as it is used in seismic prospecting.
Key words: Procedures, the surface, parameters, boundary, the subsurface, seismic survey.

1. Introduction

One of the main operations in the process of processing the observed data used in reflexion or refraction seismic prospecting is to leave out the influence of the surface area by applying static corrections.

The operation of diminishing the observed data actually lies in leaving out the effect of the topographical relief, present in the upper part of the geological cross-section, as they introduce a series of anomalies into the observation periods.

In order to do this, the use of some methods for determining the parameters of the surface zone is required with a view to bringing all the observed data to a sole reference plane.

2. Procedure for determining the surface zone parameters

The terrain relief whose elevation is furnished by the topographical works, the propagation velocity of elastic waves in the rock determined by seismologging, or the times of the first arrivals, constitutes the necessary parameters on whose basis the static corrections used in seismic prospecting can be calculated.

In order to do this, a series of special workings are carried out in the field, such as seismologging, short refraction profiles or the methods based on the data of seismic recordings are resorted to.

2.1 *Determining the parameters of the boundary in the subsurface by the seismologging methods*

The seismologging works are carried out in bore holes where elastic waves are being generated.

Seismologging can be either direct or inverse according to hether the blast takes place at the surface (bore hole mouth) and the reception is done in the bore hole, or the wave generation is done in the bore hole and the reception takes place at the surface (fig.1).

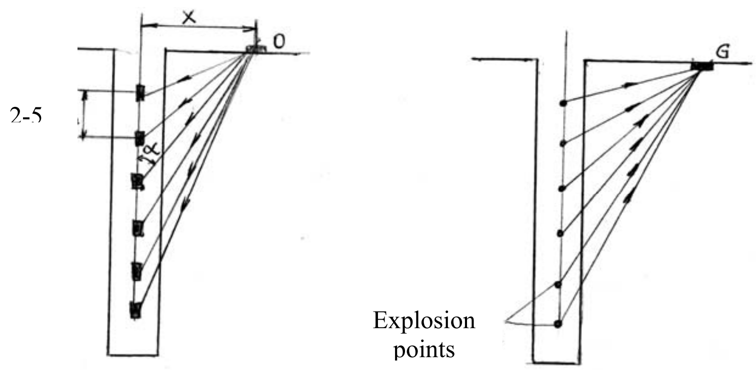

Fig. 1 *Direct and inverse seismologging in bore holes*

Direct seismologging uses a set of geophones which are introduced into the bore hole, performing a sole recording as a result of the generation of elastic waves at the surface.

Either an explosive source or surface sources such as the Dynoseis method or the fall of weights on the ground can be used in order to produce elastic waves.

The inverse seismologging is more rarely used because of its lower productivity. With this method, the elastic wave reception is done with a single geophone, and the generation is done in-sequence from the bore hole bottom to the surface.

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In this case, the elastic wavers are produced only by means of explosive sources.

As a no longitudinal vertical graph (hodograph) can be obtained with the observed data recorded in the field the first processing operation lies in turning this hodograph into a vertical longitudinal one. In order to do this, the observation periods are multiplied with the cosine of the angle formed between the bore hole axis and the seismic source direction, according to the relation:

$$tg\alpha = t_{obs} \cdot \cos\alpha \; ; \qquad (1)$$

the α angle is determined for each geophone position with the relation:

$$tg\alpha = \frac{x}{h} \; ; \qquad (2)$$

where: x is the distance between the bore hole axis and the first geophone.

h – the depth at which the explosive source is placed in the bore hole.

With the values t and h we draw up the longitudinal vertical hodograph which is made up of two line segments in keeping with the number of strata marking up the surface area.

2.2 Determining the boundary parameters by the refraction profiles method

Determining the parameters of the boundary in the subsurface on the basing of the refraction hodographs (fig.2) can be done on the basis of the relation which defines the equation of the refraction wave's path-time lines and which can be written:

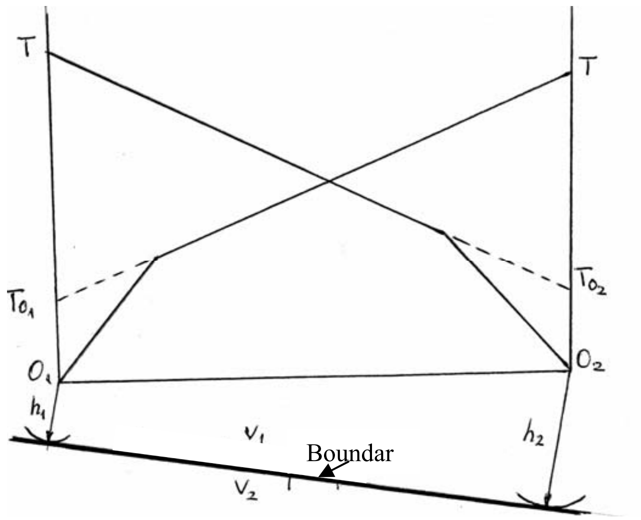

Fig. 2 *Seismic hodographs of refraction*

If in relation (3) we consider x = 0, the intersection times of the refraction line with the *y* – coordinate are obtained:

$$T = \frac{x\sin(i_c + \varphi)}{v_1} + \frac{2h\cos i_c}{v_1} \; ; \qquad (3)$$

where: x is the distance from the explosive source to the first geophone;

i_c – the critical incidence angle;

φ - the dip angle of the boundary in the subsurface;

h – the boundary depth;

v_1 – the elastic waves propagation velocity.

$$T_{O_1} = \frac{2h_1 \cos i_c}{v_1} \; ; \; T_{O_2} = \frac{2h_2 \cos i_c}{v_1} \; ; \qquad (4)$$

The depths at which the boundary in the subsurface lie can be found with these relations:

$$h_1 = \frac{T_{O_1} \cdot v_1}{2\sqrt{1-(\frac{v_2}{v_1})^2}} \; ; \; h_2 = \frac{T_{O_2} \cdot v_1}{2\sqrt{1-(\frac{v_2}{v_1})^2}} \; ; \qquad (5)$$

Other important parameter is the critical refraction distance that is the distance reached at the same time both by the direct (surface) wave and the longitudinal wave. For the analytic calculus of this distance, the condition is laid that the arrival time of the two waves should be the same and the value of x_c is obtained:

$$x_c = 2z\sqrt{\frac{v_2 + v_1}{v_2 - v_1}} \qquad (6)$$

3. Conclusions

The two important parameters in seismometry, that is the critical refraction x_c and the distances h_1 and h_2 at which the boundary lies in the subsurface, can be obtained by means of the equations of the refraction hodograph.

In order to obtain a selection at the recording of the impulses on the seismographic record it is necessary that the geophones should be placed at a greater distance than the critical refraction distance, that is $x>x_c$. In this way, the first waves that will reach the geophone will be longitudinal waves which are the object of study in seismic prospecting.

References

[1] Orban, T.
Prospecțiuni geofizice. Bucureşti 1987. Editura Universității Bucureşti.

[2] Tanev, T., Koehler. F.
Estimation and correction of nearsurface time anomalies. Geophysical prospecting, vol. 39, no. 4, 1978.

[3] Voin V.
Prospectarea si explorarea zacamintelor, Editura Corvin Deva, 1998.