MODEL ANSWER

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Exam: Advanced Seismic survey
(G 682)
Time: 120 Minutes

Answer the Following questions: …… (120 Marks)

I- Seismic Data Processing is the computational analysis of recorded data to create a subsurface image and estimate the distribution of properties. *What is the seismic data processing? Discuss the processing steps.* .....(35 Marks)

Alteration of seismic data to suppress noise, enhance signal and migrate seismic events to the appropriate location in space. Seismic processing facilitates better interpretation because subsurface structures and reflection geometries are more apparent.

Seismic reflection data are subjected to various processing steps to enhance reflected signals, attenuate noise not dealt with during acquisition, and to present the data in a more interpretable format. In most cases, signals to be enhanced are primary reflections that occur within (or very nearly within) the plane of the seismic profile.

Processing steps typically include analysis of velocities and frequencies, static corrections, deconvolution, normal moveout, dip moveout, stacking, and migration, which can be performed before or after stacking.

II- Seismic reflection is much more sensitive to subtle changes and is capable of imaging much finer detail than seismic refraction. *What are seismic reflection and refraction used?* ..... (35 Marks)

In seismic reflection method the waves travel downward initially and are reflected at some point back to the surface, the overall path being essentially vertical whereas, in seismic refraction method, principal portion of the wave-path is along the interface between the two layers and hence approximately horizontal.

Seismic Reflection Profiling is a widely-used technique for using sound waves to image underground rock strata. It is widely-used by earth scientists, and plays an important role in oil exploration. It can be performed on both land and sea. A marine example is given here.

Seismic refraction is a geophysical principle (see refraction) governed by Snell's Law. Used in the fields of engineering geology, geotechnical engineering and exploration geophysics, seismic refraction traverses (seismic lines) are performed using a seismograph(s) and/or geophone(s), in an array and an energy source.

III- Write on the following: .....(50 Marks)

1- Application of shallow seismic methods to engineering, environmental and groundwater investigations

During the last two decades, various seismic methods have been developed and widely used to study the shallow subsurface for different purposes.

The applications considered include the following cases:

- high-resolution reflection surveys for mapping recent faulting at construction sites and for studying aquifer structure in a region suffering from insufficient water supply;

- Refraction surveys for detecting a shallow salt layer in sinkhole areas and for estimating the thickness at an archeological site;

- shear wave survey for site effect evaluation for seismic risk assessment at a bridge construction site in a seismically active area.

The considered examples show that the results of shallow seismic surveys can provide important information for the solution of various problems related to studying the upper part of the geological section.

2- Application of multichannel seismic reflection method to hydrocarbon exploration

Controlled-source seismology comprises a variety of geophysical methods to image and to physically parameterize the subsurface geologic structures and conditions. All these methods base upon the principle that artificially generated shock waves travel through the subsurface and that the returned signal can be analyzed regarding the properties of the subsurface.

During the last decades the discrepancies between marine seismic equipment as used by the academic marine research community and that used by the hydrocarbon (HC) exploration industry increased significantly, caused by different research targets and the simple fact that gear commonly used for HC exploration is much too costly.

In principle, seismic data acquisition requires an energy source, a receiver, and a recording system. The two most important seismic methods are reflection and refraction seismology (Fig. 1).

Reflection seismologists deal mainly with steep angle reflections, which means that the source to receiver distance is small compared to the target depth. This method utilizes the fact that a small part of the down-going energy is reflected on geological layer boundaries.

The main fraction of the energy is transmitted and travels deeper where reflections occur at the next layer boundary and so on. This method results in a good vertical and horizontal structural resolution of the subsurface.

Earth scientists benefit from the technical and methodical developments of the exploration industry which uses reflection seismology for the detection of oil and gas in depths of up to several kilometers below the seafloor.