BSMN 213: METALLIC AND INDUSTRIAL DEPOSITS

GEOLOGICAL EXPLORATION

TO INSERT IMAGES OF GEOLOGICAL EXPLORATION

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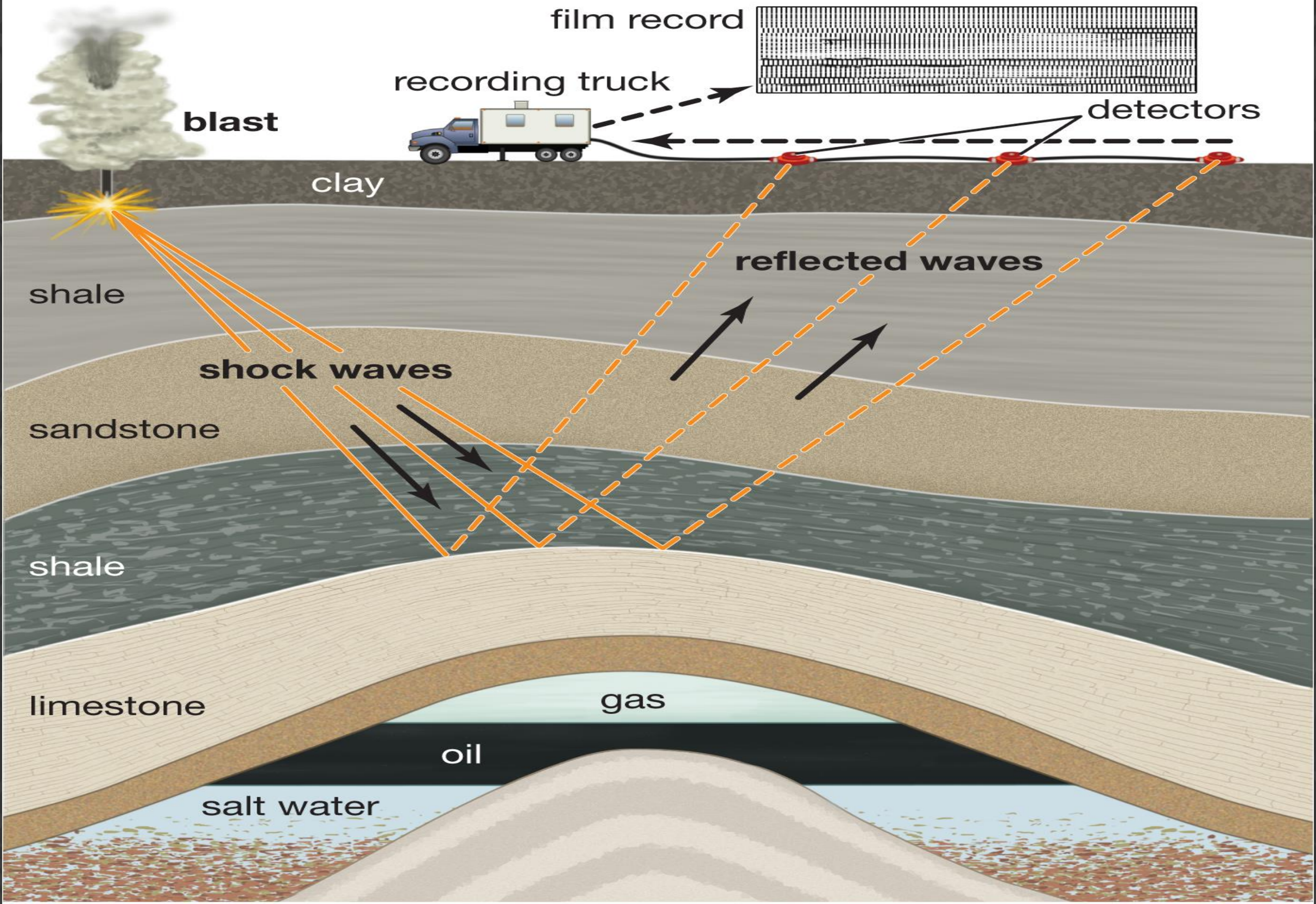
Seismic exploration



INTRODUCTION

Prospectors have made a tremendous contribution to the development of the world’s mineral resources. Since the time of the earliest settlement, the need for iron for tools and guns, lead for bullets, and copper for utensils has prompted a search for sources of these metals.

The lure of gold and silver provided the impetus for much of the development in the West between 1850 and 1910. Later, as the world's industrial demands for metals expanded to include zinc, molybdenum, tungsten, chromium, vanadium, and many others, these in turn were sought and found by prospectors.

PROSPECTING TECHNIQUES

The prospector of today has advantages which to some extent make up for the increased difficulty of finding ore deposits. One of these advantages is a greatly increased knowledge about the geologic factors that have localized ore deposition. But the search for new deposits has become a complex undertaking, and the prospector should be as well informed as possible. He should acquire the ability to identify not only ore minerals, but also common rocks and their minerals, and he must be familiar with the main kinds of geologic structures. This knowledge is best acquired by academic training,

A prospector can outfit himself in various ways according to his means and the minerals that he seeks. Equipment can be used in many ways and its effectiveness depends in large measure on the versatility of the operator. For example, the radiation counter, of which the well-known Geiger counter is one, not only can detect radioactive minerals directly, but indirectly can do more.

A "black light," which is commonly used in prospecting for scheelite (an ore of tungsten), also is useful in identifying fluorescent calcite, barite, or fluorite which in turn can be clues to the location of metallic mineral deposits.

GEOCHEMICAL PROSPECTING

For centuries men have successfully located mineral deposits by following "float" uphill to its source. When rocks are being eroded, fragments of ore minerals are carried downhill by gravity and downstream by water. The train of fragments can be traced uphill to its source.

Many mineral deposits are not exposed at the earth's surface. They may either be concealed by thick soil cover, or they may lie buried beneath layers of rock. To find these deposits more complex techniques—based on geochemistry, geophysics, and geobotany can be very helpful. Most of these techniques require specialized training and expensive equipment.

Geochemical prospecting is based on systematic measurement of one or more of the chemical properties of rock, soil, glacial debris, stream sediment, water, or plants. The purpose is to discover zones in the soils or rocks that contain comparatively high concentrations of particular elements that will guide the prospector to a hidden deposit.

Analytical methods used in geochemical prospecting must be sensitive enough to determine minute amounts of key elements, accurate enough to show small differences in concentration, fast enough to permit large numbers of samples to be analyzed in a day, and in expensive.
Wet chemical techniques are usually confined to rapid colorimetric procedures that require a minimum of equipment and reagents. Instrument techniques (such as emission spectrographic and X-ray fluorescence techniques) require expensive equipment and trained personnel, but usually yield a lower cost per determination if thousands of samples must be analyzed.

Definition some terminologies.

1. Geophysical prospecting.

The combination of sciences of physics and geology to locate ore deposits.
Familiar examples of geophysical prospecting include the use of geiger counters for detecting radioactive uranium deposits and magnetic surveys to find iron deposits.

Five major geophysical methods.

- Magnetic,
- Gravimetric,
- Electrical,
- Radiometric,
- Seismic

Below are successfully utilized in mineral exploration. Some of these methods require complex and costly instruments and highly trained operators.

- **Magneic Method**

Magnetic prospecting is based on the fact that some minerals, such as magnetite, are themselves natural magnets. The needle in a compass held near a magnetite-rich rock behaves erratically because the earth's magnetic field is distorted by the local magnetic field. Minerals such as ilmenite (iron-titanium oxide), hematite (iron oxide), and pyrrhotite (iron sulfide), are weakly to moderately magnetic, and their effects can be recorded by sensitive magnetic instruments.

Instruments such as the magnetometer and the dip needle are used directly to detect large anomalies over magnetic iron-ore bodies.

The dip needle is a pivoted magnetized needle enclosed in such a way that the case can be held vertically and the needle can rotate in a vertical plane. For use, the needle is set in a horizontal position by adjusting a counterweight that is attached to one arm of the needle. If no disturbing magnetic masses are present, the needle will remain in a horizontal position, but if a magnetic mass is present, the needle will be "pulled" away from the horizontal and thus will dip at varying angles, depending on the magnetic intensity of the disturbing mass and the orientation of the needle with respect to the magnetic field. In general, the more highly magnetic the rock mass, the steeper will be the angle of dip of the needle.

- **Radiometric Methods**

Naturally occurring radioactive elements such as uranium or thorium break down or decay to other elements or isotopes by emission of subatomic particles. Gamma rays (similar to X-rays but of higher frequency), alpha particles (nuclei of helium atoms), and beta particles (electrons) are the most common particles emitted during this process.

The portable Geiger and scintillation counters, which detect differences in the intensity of radioactivity, have been widely and effectively used in prospecting for uranium and thorium deposits in recent years. These instruments are sensitive to very small differences in amounts of radioactive elements in rocks, but they do not tell what element produces the radioactivity.

The Geiger counter is a tube filled with a gas such as helium, argon, or krypton. A high-voltage wire extends into the central part of the tube. When gamma radiation or beta particles pass into the tube from a radioactive source, some of the rays collide with gas molecules and produce electrically charged particles which are then attracted to the central wire and produce electrical pulses. The electrical pulses can be translated into dial readings of counts per minute. Scintillometers utilize crystals of certain compounds, such as sodium iodide, which emit flashes of light when struck by radiation.

In using radiation counters in the field, the most common procedure is to walk over the terrain while listening to the counts on earphones or watching the dial of the counter. Radioactive deposits may produce readings that are 10 or 100 times as great as "background."

- **Seismic Method**

Exploration and development surveys are conducted to obtain data on geological formations from the sediment near-surface to several thousand meters deep (below the sediment surface). This information enables industry accurately to assess potential hydrocarbon reservoirs and helps to optimally locate exploration and development wells, maximizing extraction and production from a reservoir.

This information enables industry accurately to assess potential hydrocarbon reservoirs and helps to optimally locate exploration and development wells, maximizing extraction and production from a reservoir. A survey vessel tows an array (or dual arrays) of high-pressure "airguns," which serve as the sound source. In conventional 2D and 3D seismic surveys, the receivers (hydrophones) are on streamer cables towed behind the survey vessel at a depth of 5 to 10 m below the surface of the water. Individual streamers can
be up to 12 km in length or, on rare occasions, even longer.

Gravimetric Methods

Application of gravimetric surveying for iron ore search is related to differences in specific gravity between the iron-bearing material and the surrounding rock overburden. Gravimetric survey results are of specific value to iron ore explorationin so far known area. The variation of gravitaty encountered are extremely small and the instruments used for measurement have to be of great sensitivity.

This instruments use the elastic force of springs and the torsion of wires to measure gravity.

- **Electric Methods**

Application of this method depends on the difference in the electrical properties associated with certain minerals and rocks

Natural electric currents and distribution of self potential Properties of currents induced into earth.

Direct and alternative current

Self Potential method is applicable to the search for pyrite from which by products iron may be obtained.

All exploration techniques have their own inherent limitations and their usefulness in exploration.

Limitations of Geophysical Methods

i. Lack of sufficient contract in the physical properties on the part of the body or conditions sought.

ii. Decrease of anomaly with distance to the causative body.

iii. Marked anomalies arising from surface features.

iv. Uncertainty of interpretation as measured by the actual ore finding or ore elimination.