Environmental Geophysics

By
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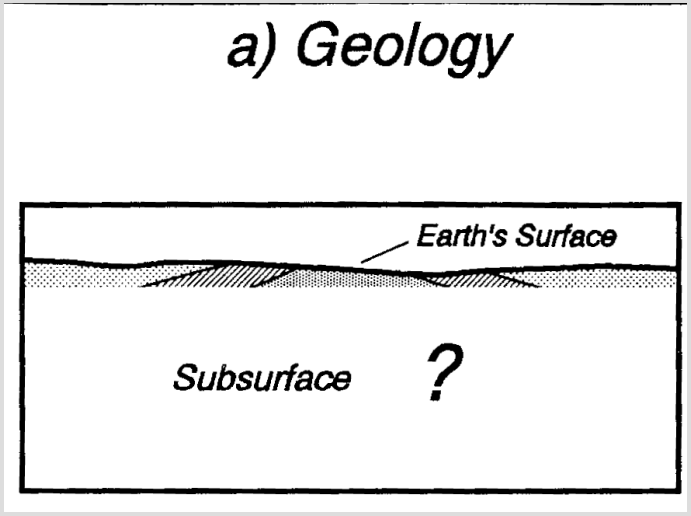
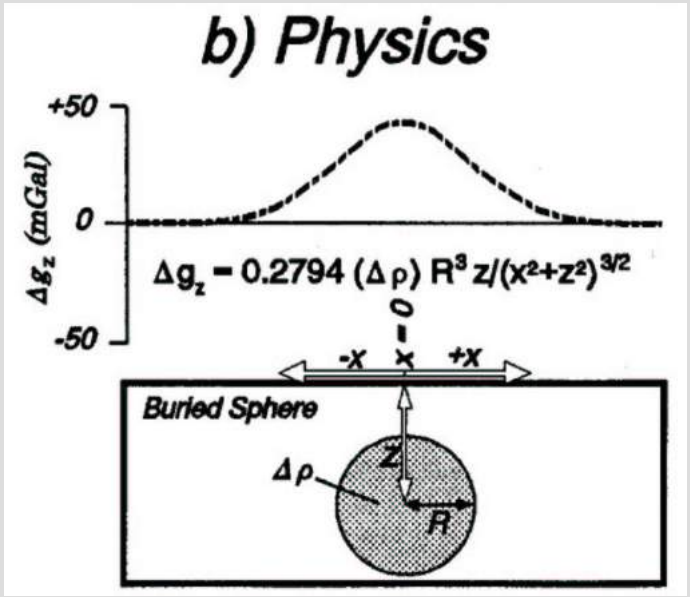
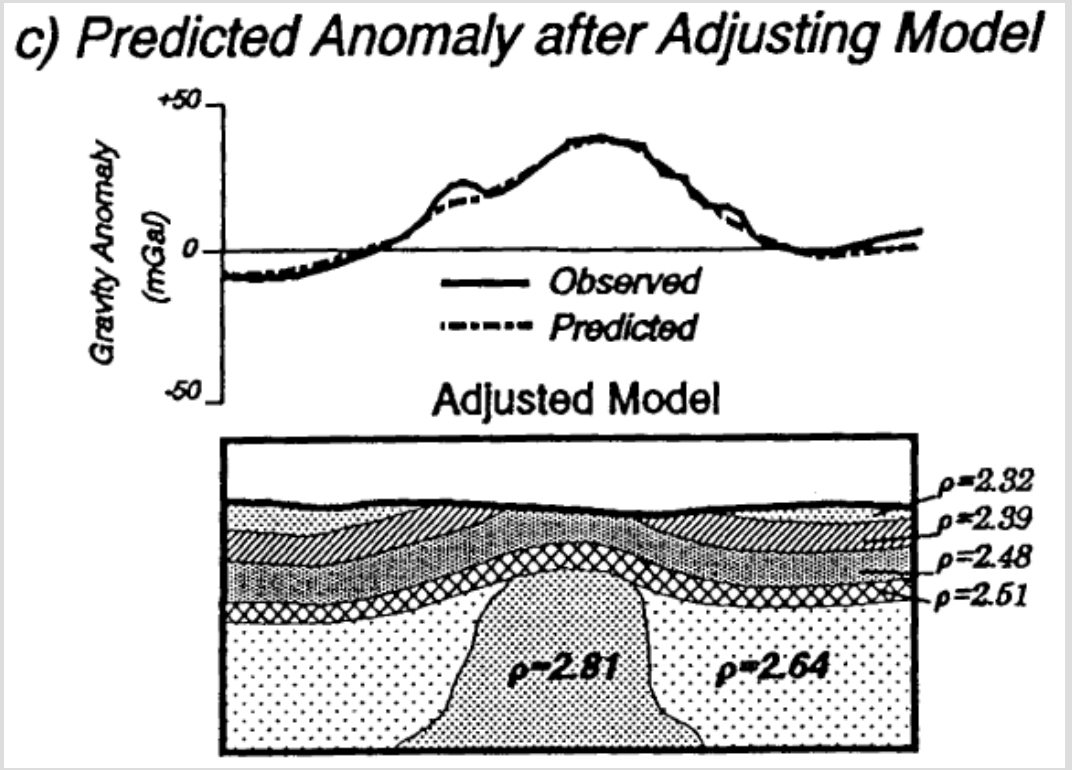
Geology + Physics=



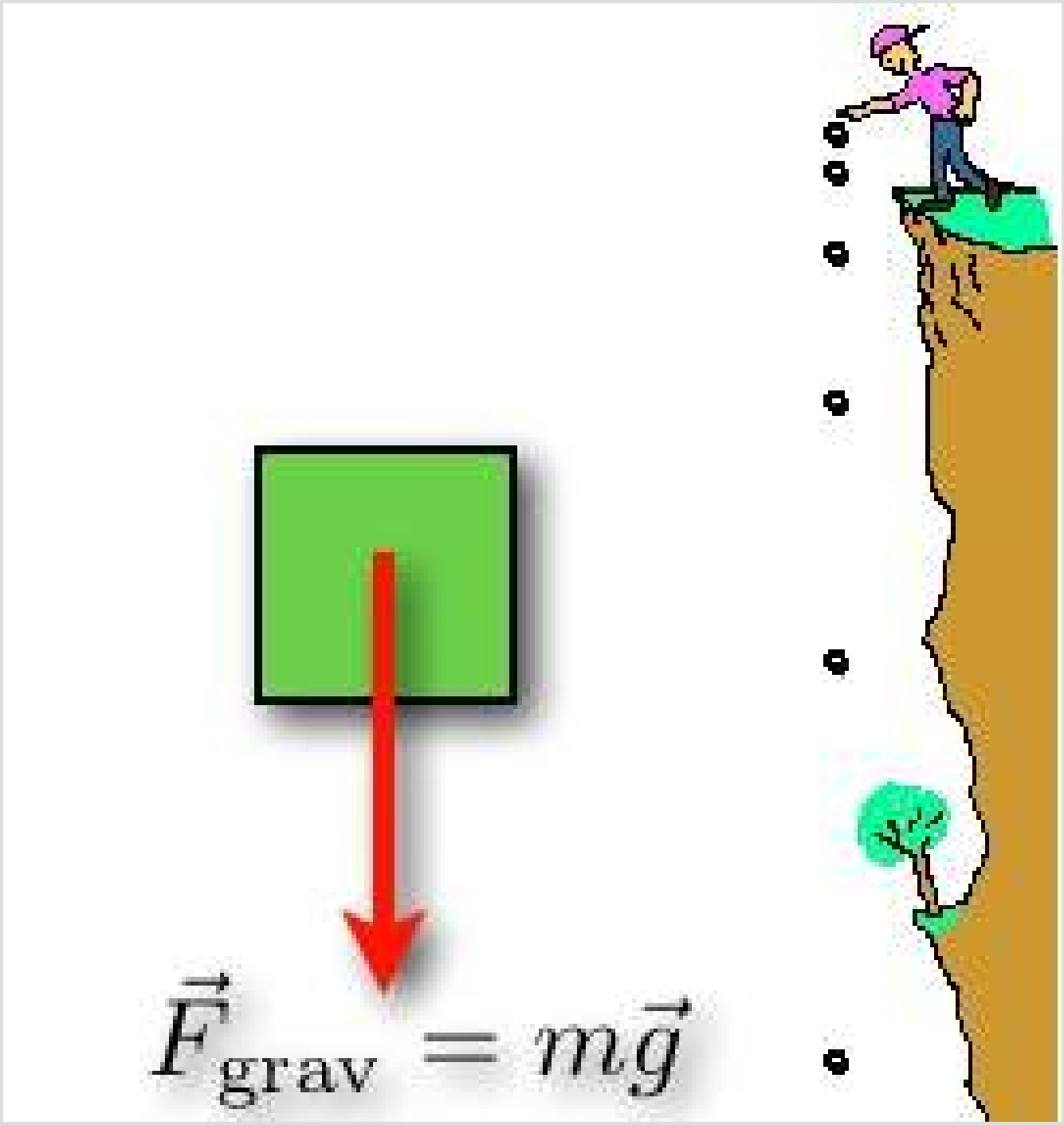


Geophysics

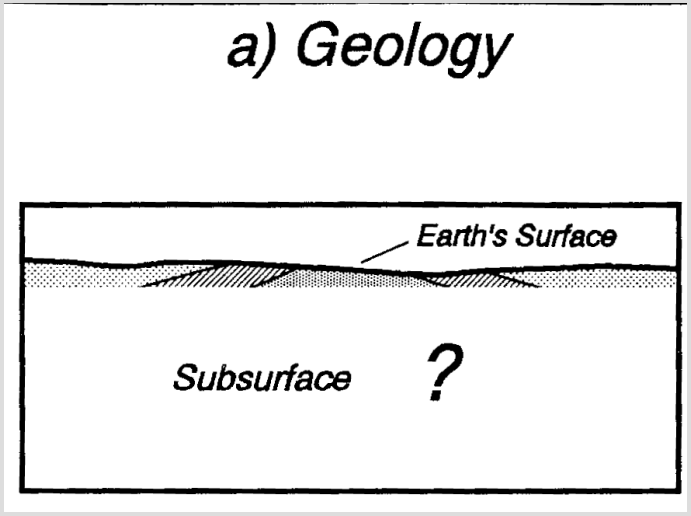


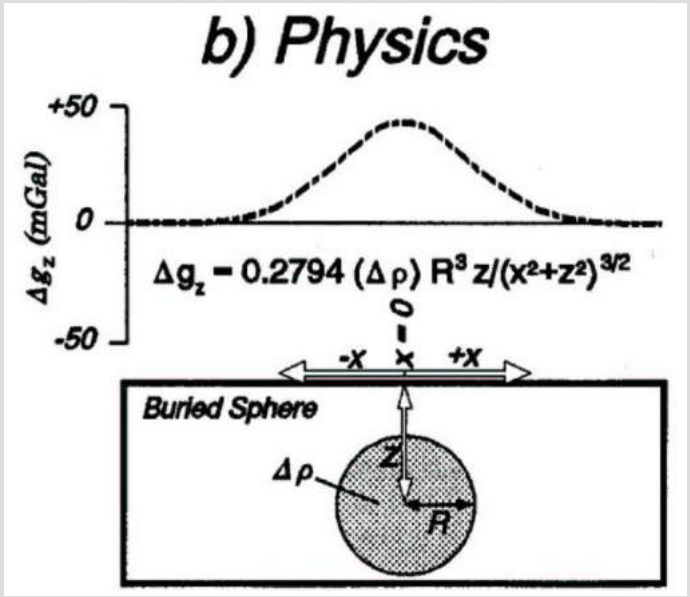
Geology

Physics

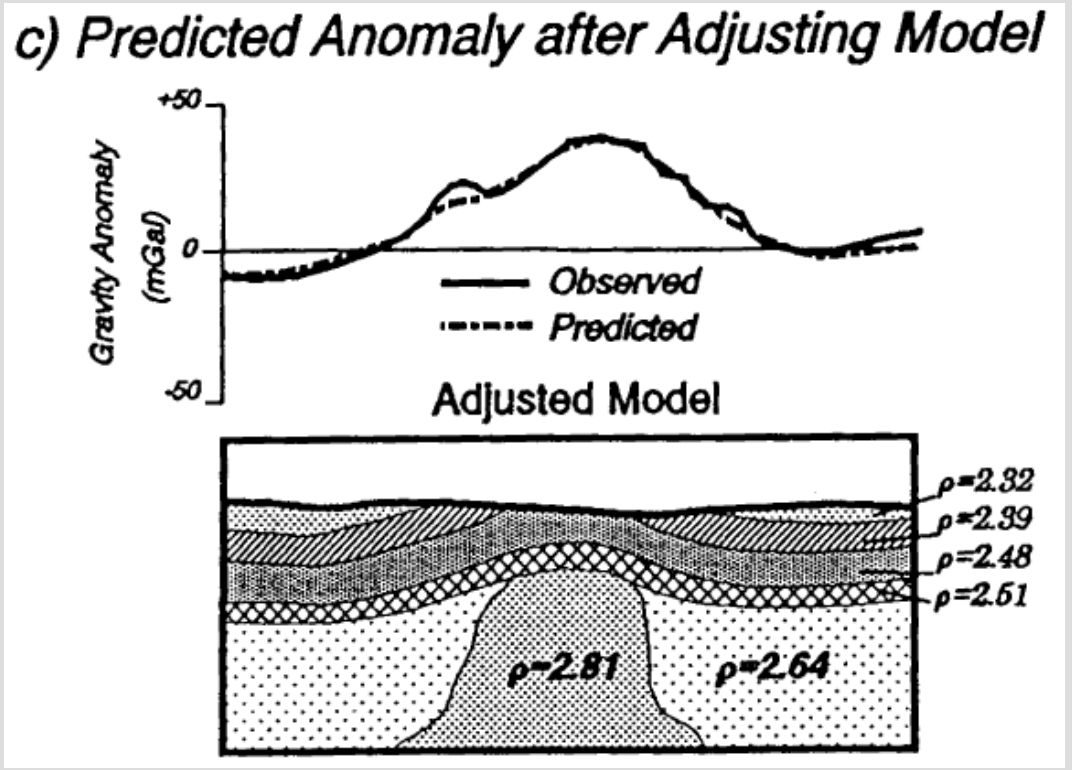


Geology + Physics=





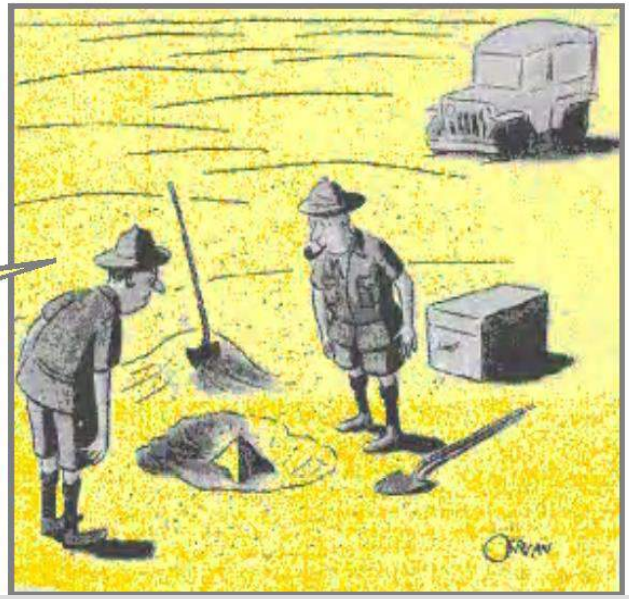
Geophysics



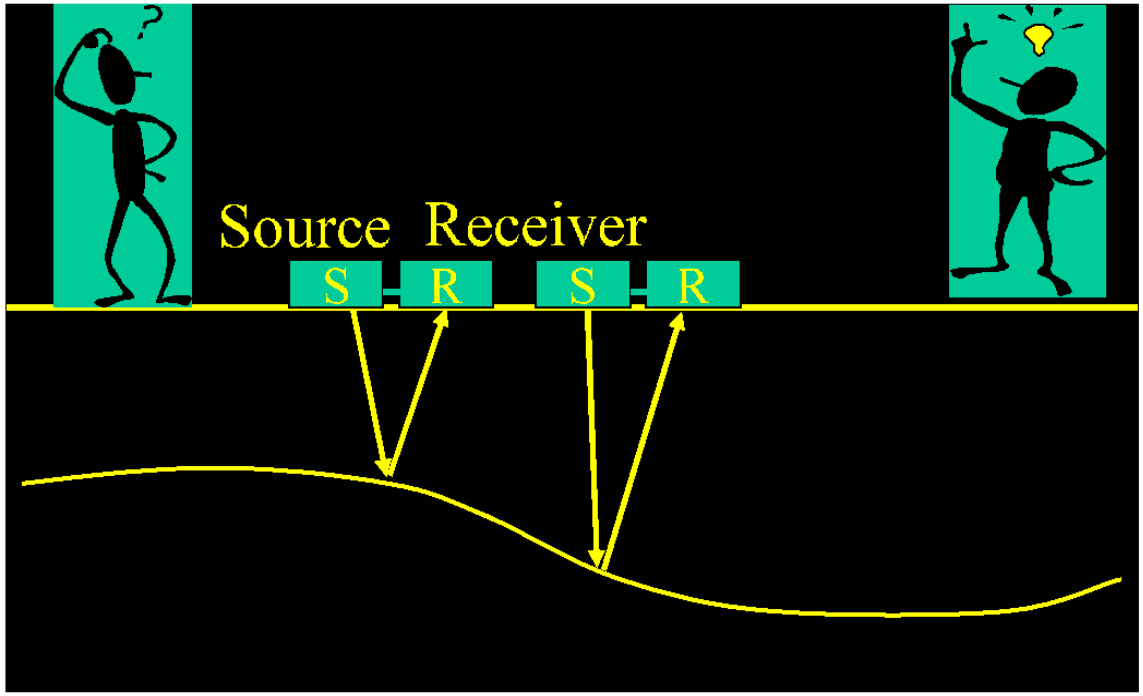
Geophysics?

- Apply the principles of physics to the study of the Earth
- Investigation of the interior of the Earth involves taking measurements at or near the Earth´s surface that are influenced by the internal distribution of physical properties. The analysis of these measurements reveals information on

  the Earth´s interior



Geophysical measurements: tool to obtain an image of the subsurface



Measurement → Processing → Image

- Mapping of geological structure
- Detect objects

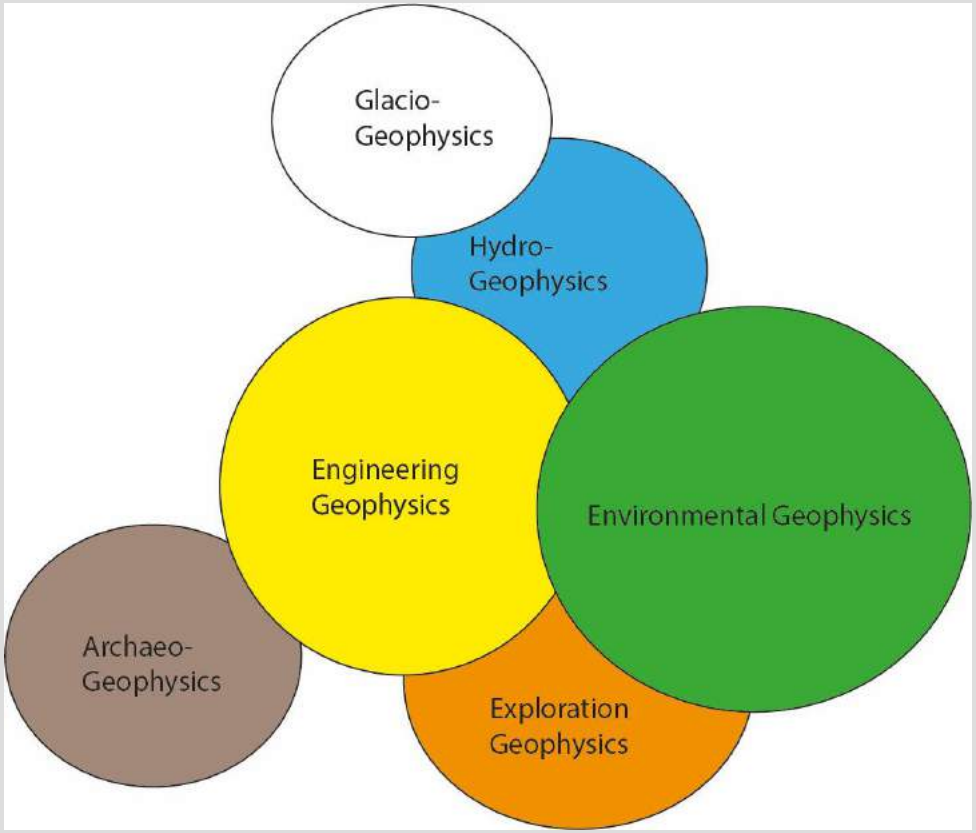
Lets Know the Environmental Geophysics

Environmental geophysics is a relatively new field.

It is primarily used to identify, map or predict the presence and movement of subsurface contaminants in the soil within the upper 10 to 50 m of the Earth's surface.

The definition of Environmental Geophysics

The Environmental Geophysics can be defined as the application of geophysical methods to the investigation of near-surface physico-chemical phenomena which are likely to have (significant) implications for the management of the local environment.



Application of Geophysical methods in various sectors

Environmental geophysicists often are part of multi-disciplinary teams which include geological engineers, biologists, hydrogeologists and technicians.

Environmental geophysicists use many of the instruments and techniques used in mining and petroleum geophysics such as magnetic, electrical and seismic methods.

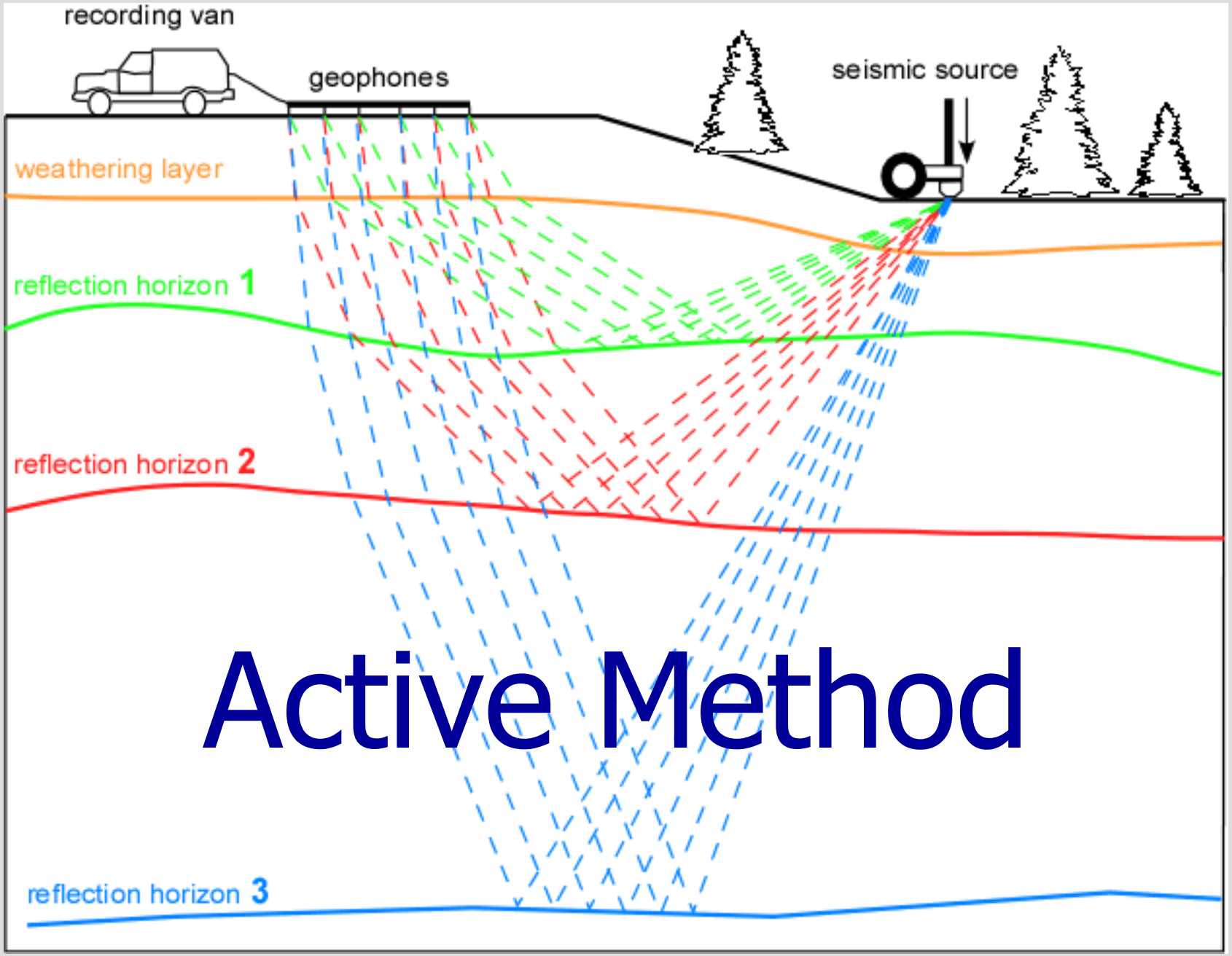
Methods applied in Environmental Geophysics

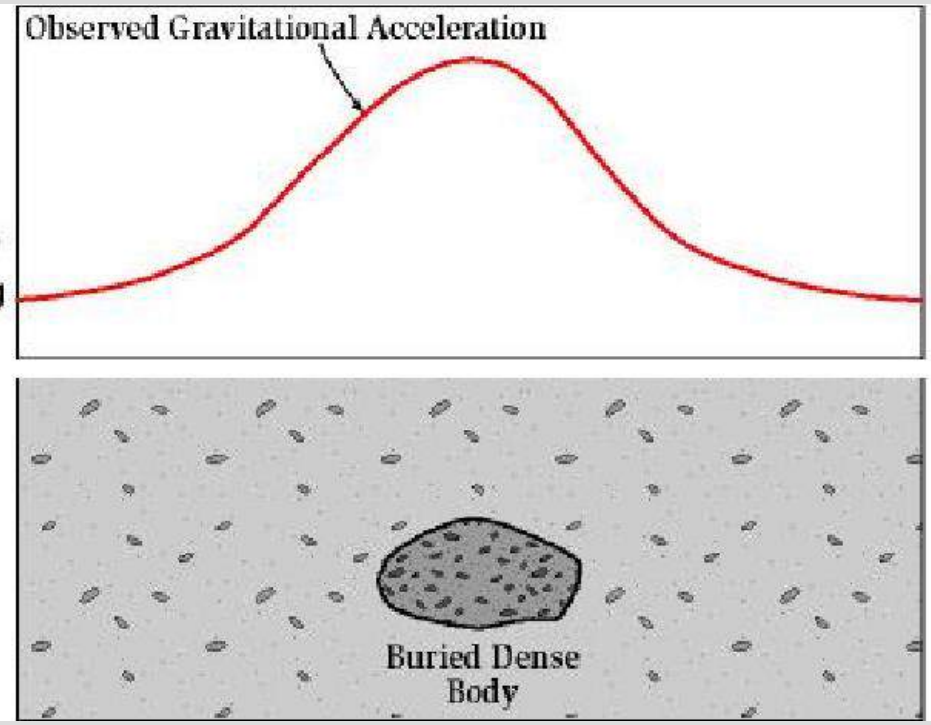
Active	Passive
1- Seismic method	1-Gravity method
2- Electric method	2-Magnetic method
3- GPR method	
4- Spontaneous Potential Method	
5- Induced Polarisation method	
6- Electro magnetic method	

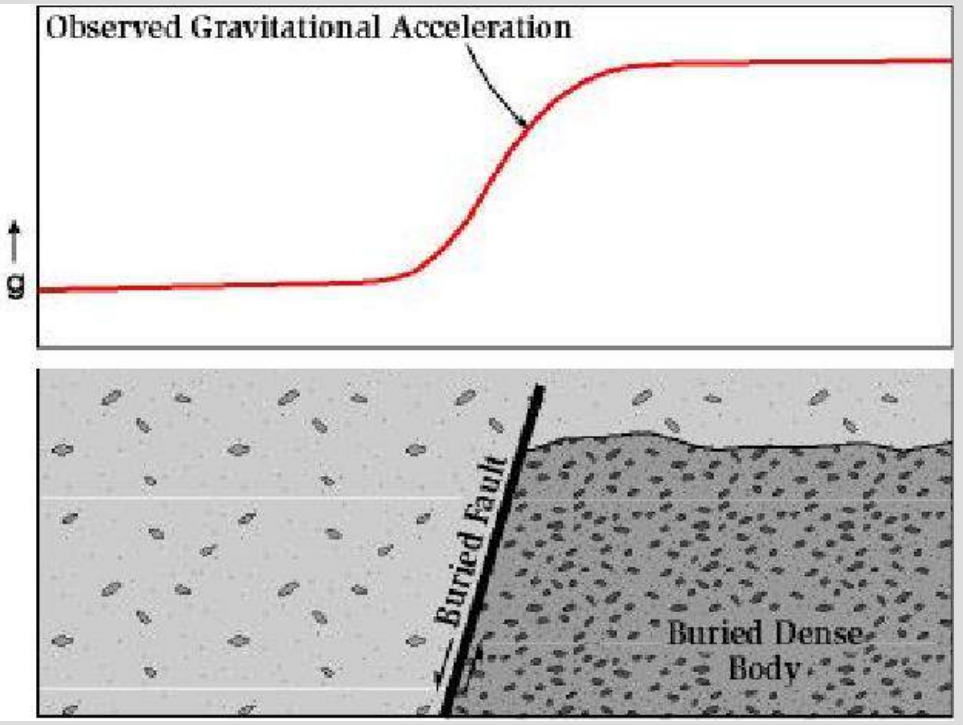
Notes:

Active Methods : Depend on artificial source

Passive methods: Depend on natural source


recording van
geophones
seismic source
weathering layer
reflection horizon 1
reflection horizon 2
reflection horizon 3
Active Method





Passive Method

Table 1.1 Geophysical methods and their main applications

Geophysical method	Chapter number	Dependent physical property	Applications (see key below) 1	2	3	4	5	6	7	8	9	10
Gravity	2	Density	**P**	**P**	s	s	s	s	!	!	s	!
Magnetic	3	Susceptibility	**P**	**P**	**P**	s	!	m	!	**P**	**P**	!
Seismic refraction	4,5	Elastic moduli; density	**P**	**P**	m	**P**	s	s	!	!	!	!
Seismic reflection	4,6	Elastic moduli; density	**P**	**P**	m	s	s	m	!	!	!	!
Resistivity	7	Resistivity	m	m	**P**	**P**	**P**	**P**	**P**	s	**P**	m
Spontaneous potential	8	Potential differences	!	!	**P**	m	**P**	m	m	m	!	!
Induced polarization	9	Resistivity; capacitance	m	m	**P**	m	s	m	m	m	m	m
Electromagnetic (EM)	10	Conductance; inductance	s	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	m
EM–VLF	11	Conductance; inductance	m	m	**P**	m	s	s	s	m	m	!
EM – ground penetrating radar	12	Permitivity; conductivity	!	!	m	**P**	**P**	**P**	s	**P**	**P**	**P**
Magneto-telluric	11	Resistivity	s	**P**	**P**	m	m	!	!	!	!	!

P = primary method; s = secondary method; m = may be used but not necessarily the best approach, or has not been developed for this application; (!) = unsuitable

Applications

1 Hydrocarbon exploration (coal, gas, oil)
2 Regional geological studies (over areas of 100s of km^2)
3 Exploration/development of mineral deposits
4 Engineering site investigations
5 Hydrogeological investigations
6 Detection of sub-surface cavities
7 Mapping of leachate and contaminant plumes
8 Location and definition of buried metallic objects
9 Archaeogeophysics
10 Forensic geophysics

Active (Seismic, Electrical SP, EM etc)		Passive (Gravity, Magnetic)	
Advantage	Disadvantage	Advantage	Disadvantage
Better control of noise sources	Field equipment tends to be more complex.	Need supply only a sensor and a data recorder.	Less control of getting noise
Active experiments usually provide better depth control over source of anomalous signal	Field operations and logistics are generally more complex and time consuming	Passive experiments can be run over wider areas in a more cost-effective manner.	Identification of the source of an anomalous observation can be difficult.

Active (Seismic, Electrical SP, EM etc)		Passive (Gravity, Magnetic)	
Advantage	Disadvantage	Advantage	Disadvantage
Many different source/receiver configurations can be used allowing for a wide variety of survey designs.	Greater survey design costs and potentially leads to increased probability of field mishaps.	Provide the survey on short notice with relatively easily	This limits the amount of customisation that can be done for specific problems.
Once set up, active experiments are capable of producing vast quantities of data	Can become overwhelming to process and interpret.	Interpretation can be accomplished quickly and efficiently.	Do not allow a detailed interpretation.

What did you learn today?

Quiz 1:

What is the passive geophysical method?

a) Gravity method
b) Seismic method

Answer in the comments bellow

Thanks for watching

The First Semester

Gravity Method

Seismic Method

Electrical Method

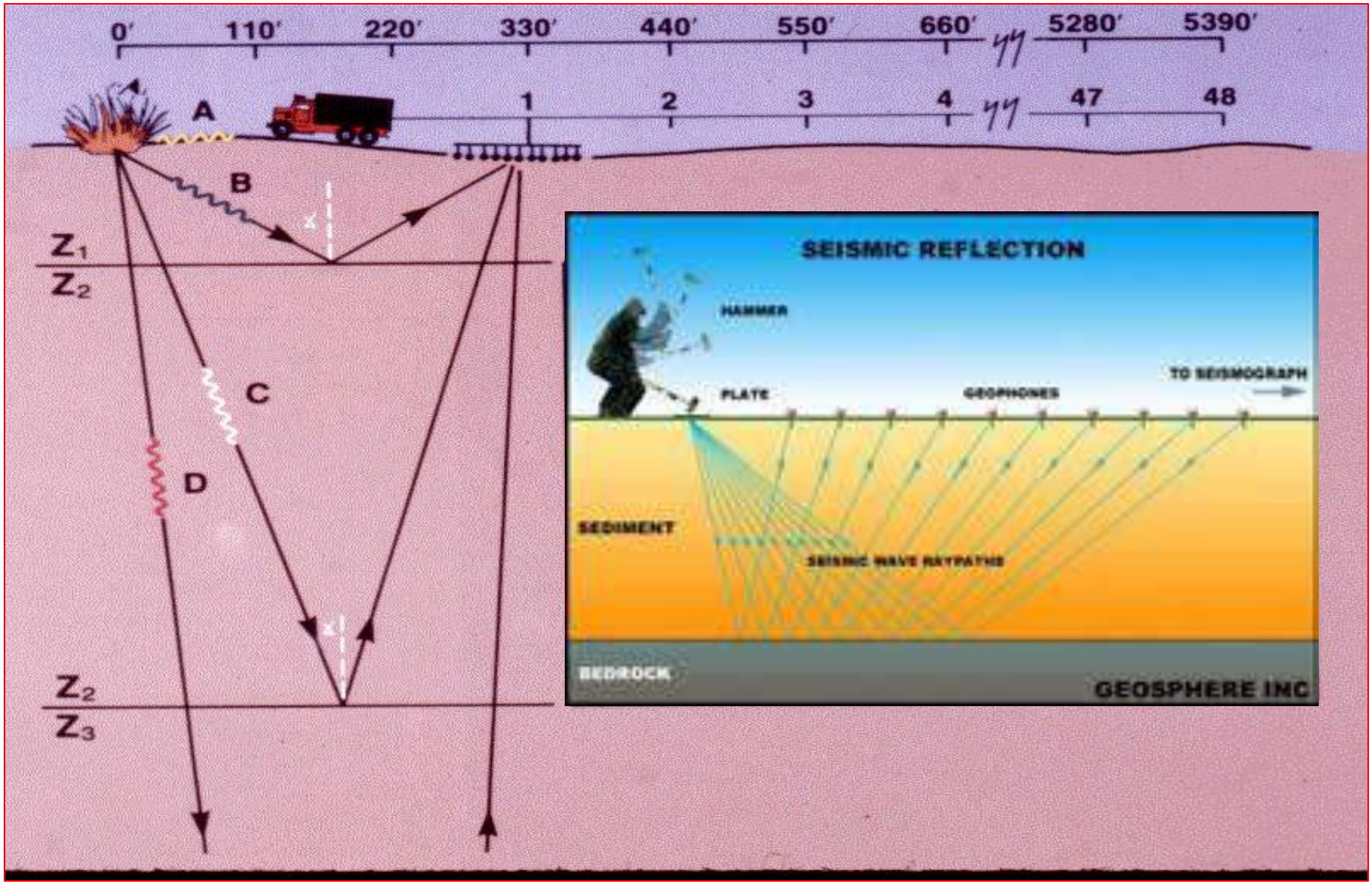
Syllabus of the Seismic Method:

- Introduction
- Theoretical background
- Elastic parameters
- Seismic Waves
- Propagation of the seismic waves
- Seismic velocity
- Geometry of reflected wave path
- Geometry of refracted wave path
- Instruments
- Data Corrections
- Data Processing
- Interpretation

References:

1. Applied Geophysics, 1996, Telford, W.,M.
2. An introduction to applied and environmental geophysics, 1997, Reynolds, J. M.
3. Introduction to geophysical prospecting, 1988, Durbin, M. B.
4. Applied and environmental geophysics, 1999, Sharma,V.,P.
5. www.Geophysics.Com
6. www.Geophysics.net

The basic techniques of the seismic method



Applications

Seismic method divides into two techniques:

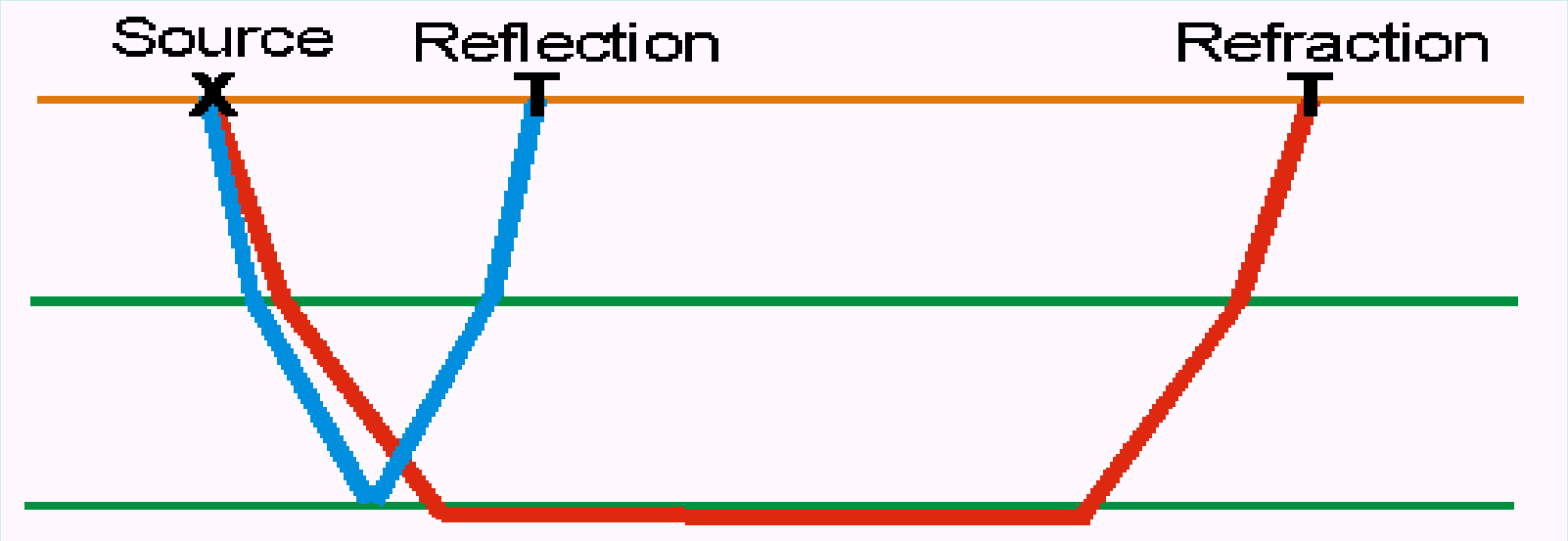
1- Seismic Refraction

- Rock competence for engineering applications
- Depth to Bedrock
- Groundwater exploration
- Correction of lateral, near-surface, variations in seismic reflection surveys
- Crustal structure and tectonics

2- Seismic Reflection

- Detection of subsurface cavities
- Shallow stratigraphy
- Site surveys for offshore installations
- Hydrocarbon exploration
- Crustal structure and tectonics

Refraction Vs. Reflection



- Seismic Refraction: the signal returns to the surface by refraction at subsurface interfaces, and is recorded at distances much greater than depth of investigation
- Seismic Reflection: the seismic signal is reflected back to the surface at layer interfaces, and is recorded at distances less than depth of investigation