Universita' di Trieste-Dipartimento di Matematica, Informatica e Geoscienze -Exploration Geophysics Group

LM in Geophysics and Geodata

EXPLORATION SEISMOLOGY

INTRODUCTORY COURSE TO REFLECTION SEISMICS

2024-25

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TEAMS

CD2024 394SM EXPLORATION SEISMOLOGY

3hw94o1

MOODLE2 UNITS

EXPSEI24&

EXPLORATION SEISMOLOGY

COURSE STRUCTURE		
LESSONS	24HRS	FUNDAMENTALS OF DATA ACQUISITION AND PROCESSING
LABORATORY	24HRS	FROM FIELD DATA TO THE MIGRATED SECTION

Exploration Seismology

Course Structure (2)
Lessons:
Reflection seismics: the method Seismic waves (basics) Instruments and data acquisition Data Processing

Course structure (3)

Objectives:

-Geological model – seismic image (1-D, 2-D, 3-D)

•Physical properties

-Physics (kinematic, dynamic))

-From measurement to seismic image: data acquisition, analysis, processing/inversion: theory and practice (seismic lab)

Course sgtructure(4)		
TOPICS	From measurement to seismic section/volume	Analysis/processing
1	Fundamentals, sources, receivers, gathers, stacking chart	Introduction to SPW and basic operations
2	Impulsive / non-impulsive seismic sources	Processing: auto-/cross-correlation, convolution
3	Geometry of wave propagation, static and dynamic correction	Fourier transform, spectral analysis and filtering
4	Velocity analysis, stack	Convolutive model of seismic trace/Inverse filtering
5	Migration	Multiple reflections

TESTI CONSIGLIATI

Sheriff R.E., Geldart L.P., Exploration Seismology (2nd Ed.)
Cambridge University Press
Yilmaz O. – Seismic Data analysis (2 vol.)
Society of Exploration Geophysicists

Ashcroft W.- A Petroleum Geologist's Guide to Seismic Reflection
Wiley-Blackwell

Liner C.L. – Elements of 3D Seismology
PennWell

Exploration seismology

Sheriff, Robert E.

Cambridge University Press 1995

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Biblioteca San Giovanni

English P009940

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Encyclopedic Dictionary
Problems in Exploration Seismology & their Solutions
Seismic Data Analysis

Translate

Page preparation
Pages in translation

Öz Yilmaz has expanded his original work on processing to include inversion and interpretation of seismic data. In addition to the developments in all aspects of conventional processing, this content represents a comprehensive and complete coverage of the modern trends in the seismic industry-from time to depth, from 3-D to 4-D, from 4-D to 4-C, and from isotropy to anisotropy.

As technology evolves and advances, help us keep this valuable contribution to geophysics up-to-date by making your own contributions that reflect the latest science of seismic data analysis and applied geophysics.

"*A geophysicist, who practices seismic data processing, inversion, and interpretation, would want to have a quick reference under his/her fingertips for the theory and practice of all processing methods and algorithms, for determining an optimum processing sequence with optimum parameters for each step --- whether it is for AVO inversion or for earth imaging in time and depth. Now, via SEG Wiki, you can access Seismic Data Analysis to obtain the information you need.*" - Oz Yilmaz, August 2014

Seismic Data Analysis

Series Investigations in Geophysics
Author Öz Yilmaz
DOI http://dx.doi.org/10.1190/1.9781560801580
ISBN ISBN 978-1-56080-094-1
Store SEG Online Store

https://wiki.seg.org/wiki/Seismic_Data_Analysis

SUPPLEMENTARY MATERIAL

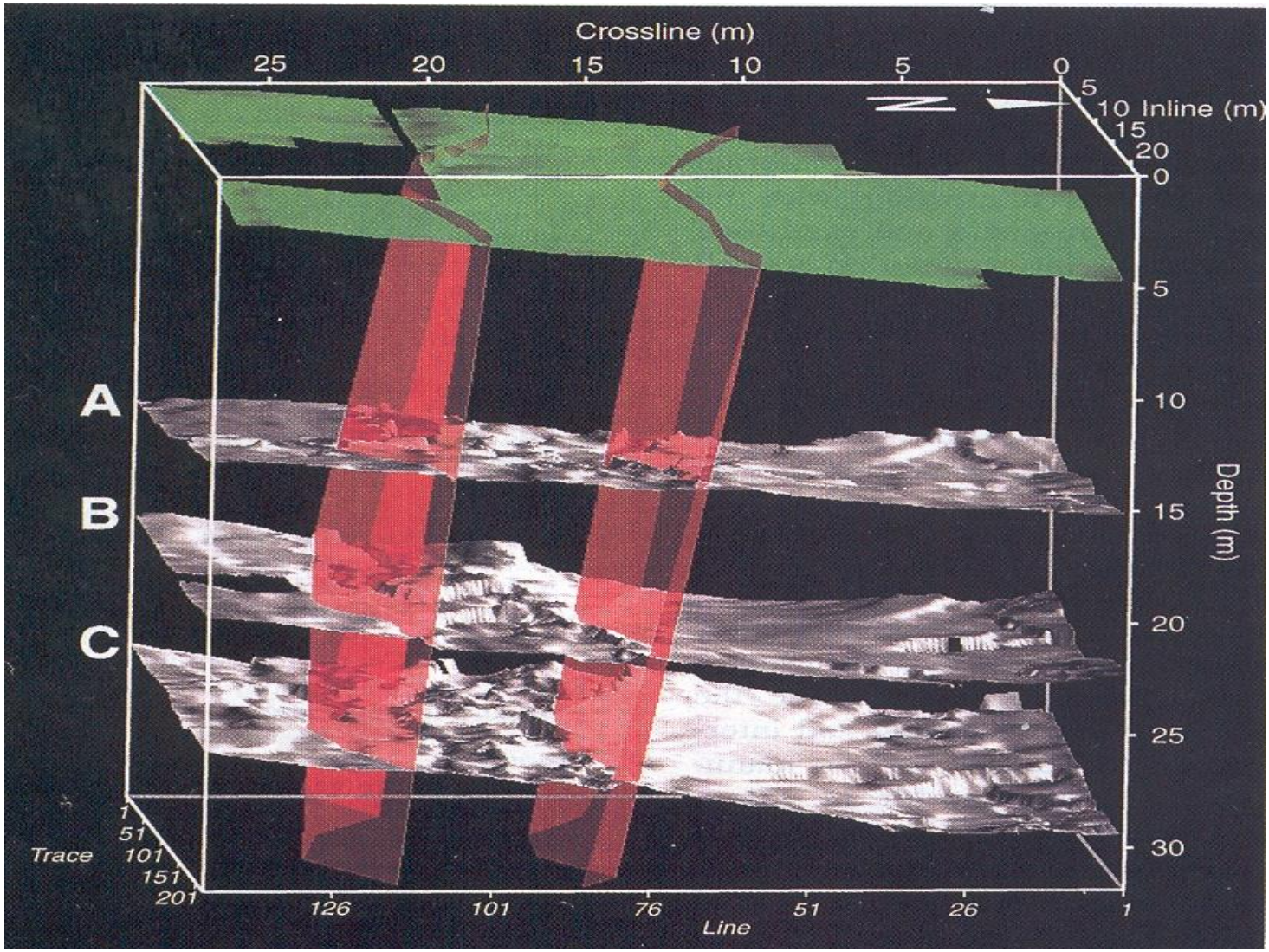
SLIDES

http://moodle2.units.it

Corso di Sismica

Examination (oral)	
Questions on theory and labs	Written report about one of the topics of the experimental (lab) part *the report is mandatory but does not contribute to the final grade*

Obiettivi (1)


Crossline (m)
25
20
15
10
5
0
N
5
10 Inline (m)
15
20
0
5
10
15
20
25
30
Depth (m)
A
B
C
Trace
1
51
101
151
201
126
101
76
51
26
1
Line

Objectives

Definitions and Objectives

Exploration seismology uses artificially generated elastic waves to obtain information about the subsurface and, in particular:

- Locating natural resources
- Obtain geological and geotechnical information for engineering
- Obtain information on the subsoil for the scientific study of the structure, stratigraphy and evolution of the earth's crust
- Characterize the subsoil (structure and characteristics of materials) for a large number of civil and industrial applications

Breve storia

1888: Bilancia di Torsione (Eötvos)

1926: Prima scoperta geofisica di giacimento petrolifero

1678: Inizio fondamenti teoria elasticita' (L. di Hooke)

1818-1924: teoria onde sismiche (Cauchy, Poisson, Knott, Wiechert, Zoeppritz, Rayleigh, Love, Stoneley)

1848: inizio sismologia sperimentale (Mallet)

1914: primo brevetto sull'uso di onde sismiche per l'esplorazione del sottosuolo (Fessenden) e primo sismografo per esplorazione (Mintrop)

Breve storia (2)

1946: Prime sezioni sismiche

1952: Prime registrazioni analogiche su nastro magnetico

1953: inizio sviluppo sorgenti alternative (terra, mare)

1956: Inizio registrazioni CMP

1960: inizio rivoluzione digitale

1976: inizio sismica 3-D

Breve storia (3)

1914	Mintrop's mechanical seismograph
1917	Fessenden patent on seismic method
1921	Seismic reflection work by Geological Engineering Co.
1923	Refraction exploration by Seismos in Mexico and Texas
1925	Fan-shooting method
	Electrical refraction seismograph
	Radio used for communications and/or time-break
1926	Reflection correlation method
1927	First well velocity survey
1929	Reflection dip shooting
1931	Reversed refraction profiling
	Use of uphole phone
	Truck-mounted drill
1932	Automatic gain control
	Interchangeable filters
1933	Use of multiple geophones per group
1936	Rieber sonograph; first reproducible recording
1939	Use of closed loops to check misties
1942	Record sections
	Mixing
1944	Large-scale marine surveying
	Use of large patterns
1947	Marine shooting with Shoran
1950	Common-midpoint method*
1951	Medium-range radionavigation
1952	Analog magnetic recording*
1953	Vibroseis recording*
	Weight-dropping
1954	Continuous velocity logging
1955	Moveable magnetic heads
1956	Central data processing
1961–2	Analog deconvolution and velocity filtering
1963	Digital data recording*
1965	Air-gun seismic source
1967	Depth controllers on marine streamer
1968	Binary gain
1969	Velocity analysis
	Transit satellite positioning
1971	Instaneous floating-point amplifier
1972	Surface-consistent statics
	Bright spot as hydrocarbon indicator
1974	Digitization in the field
1975	Seismic stratigraphy
1976	Three-dimensional surveying
	Image-ray migration (depth migration)
1984	Amplitude variation with offset
	Determining porosity from amplitude
	DMO (dip-moveout) processing
1985	Interpretation workstations
1986	Towing multiple streamers
1988	*S*-wave exploration
	Autopicking of 3-D volumes
1989	Dip and azimuth displays
1990	Acoustic positioning of streamers
	GPS satellite positioning

Investimenti per obiettivo (1991)

Object	Land	Transition	Marine	Airborne	Borehole	Percent
Petroleum						96.7
Exploration	1 189 500.	6 100.	817 900.	6 600.	1 860.	83.1
Development	252 600.	27 900.	49 300.		900.	13.6
Minerals	16 100.			11 900.	690.	1.2
Environmental	3 100.			140.	180.	0.1
Engineering	34 400.			15.		1.4
Geothermal	400		900.			0.1
Groundwater	2 200.				140.	0.1
Oceanography	10.		900.			< 0.1
Research	9 000.	300.	500.	80.	320.	0.4
Total	1 507 300.	34 300.	869 500.	18 700.	4 000.	
Percent	62.0	1.4	35.7	0.8	0.2	

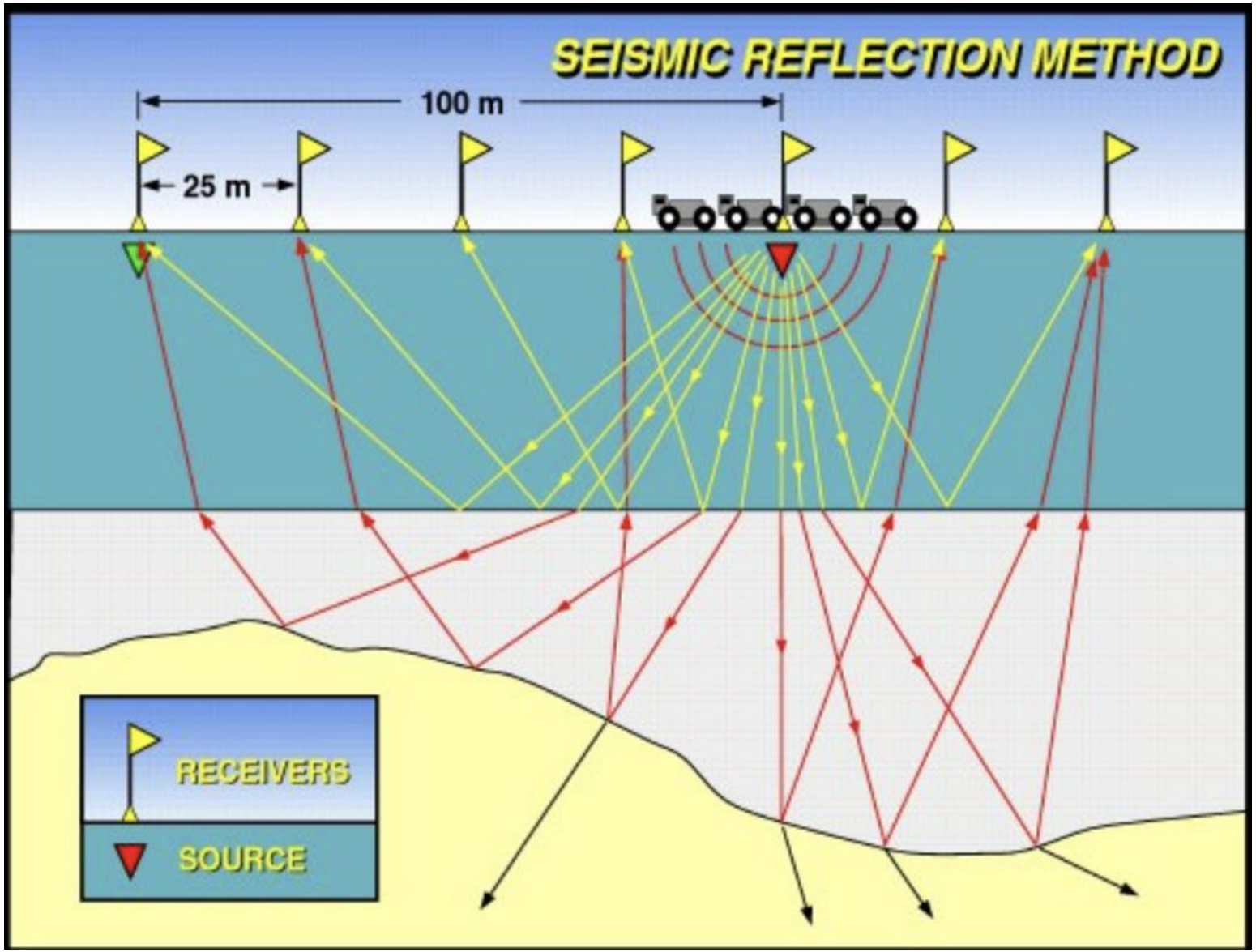
Metodo sismico a riflessione

Il metodo piu' largamente diffuso per la prospezione geofisica del sottosuolo, fondamentale nell'esplorazione e lo sfruttamento di giacimenti di idrocarburi.

Fornisce informazioni piu' dettagliate di qualsiasi altro metodo non-invasivo su stratigrafia, struttura e proprieta' dei materiali.

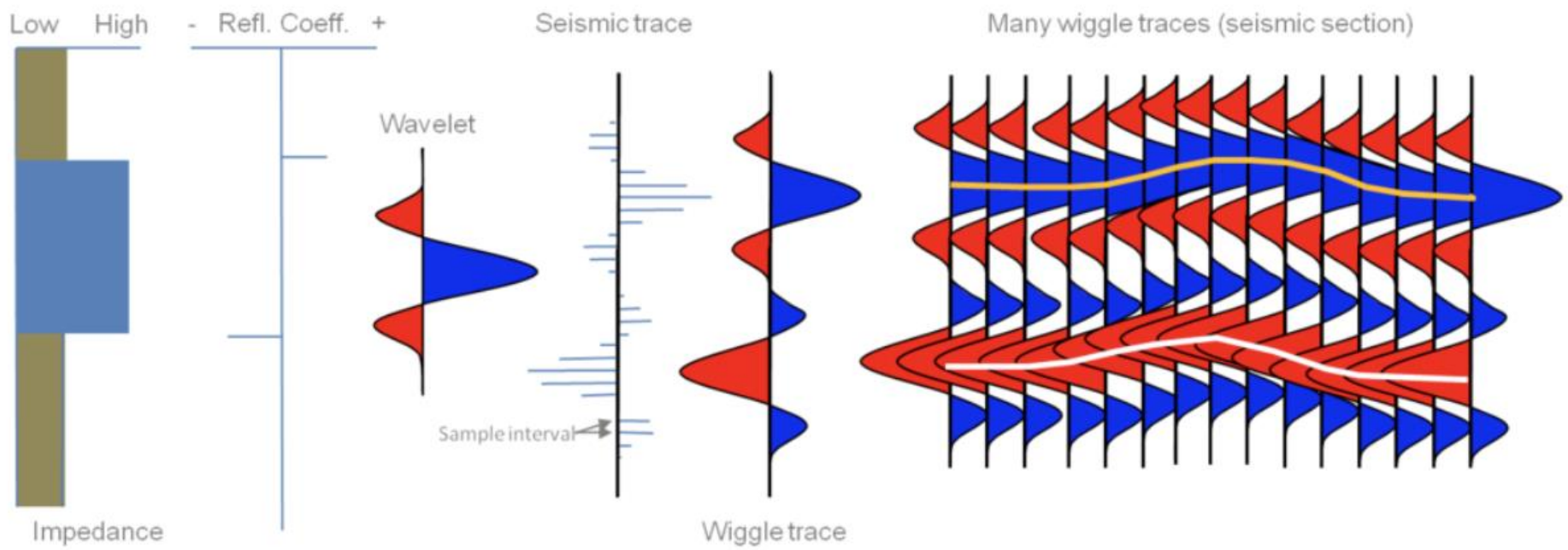
Utilizza tempi di arrivo, ampiezza e fase degli echi dalle discontinuita' nelle proprieta' elastiche presenti nel sottosuolo per ricavarne posizione e proprieta' fisiche (impedenza acustica, velocita' propagazione onde sismiche, parametri elastici)

Metodo sismico a riflessione: l'esperimento



Reflection seismics: the result

1-D 2-D

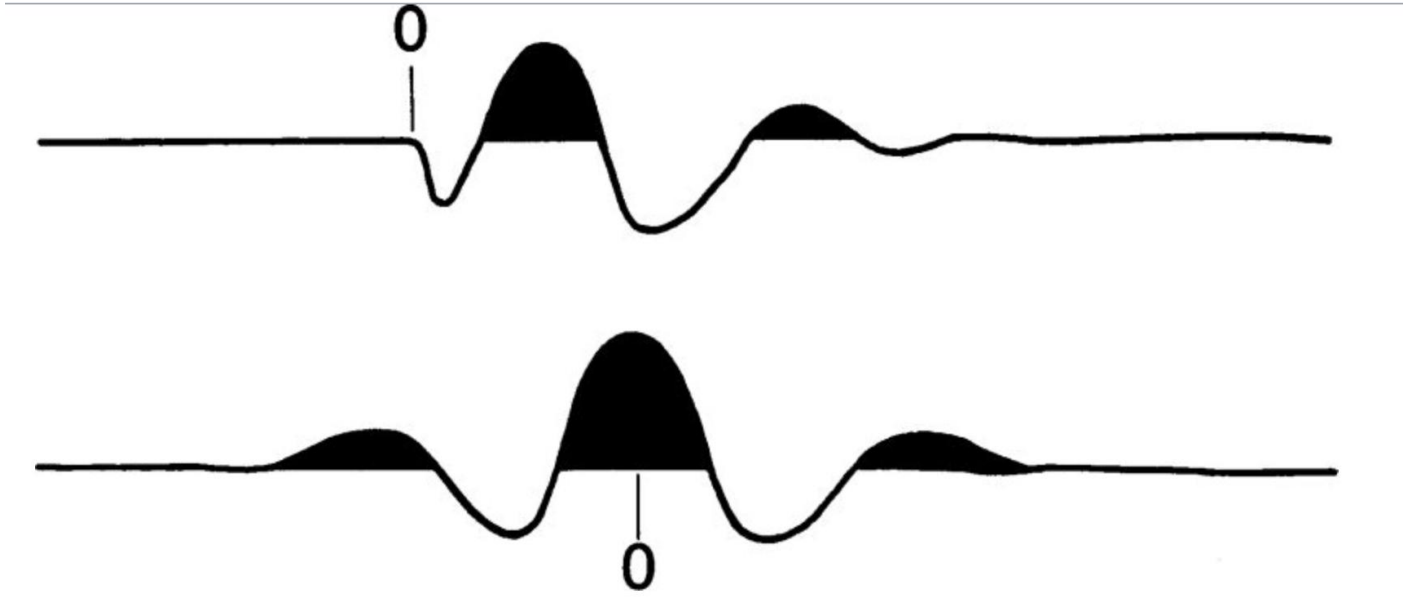


Seismic Trace Section

Reflection seismics: polarity convention

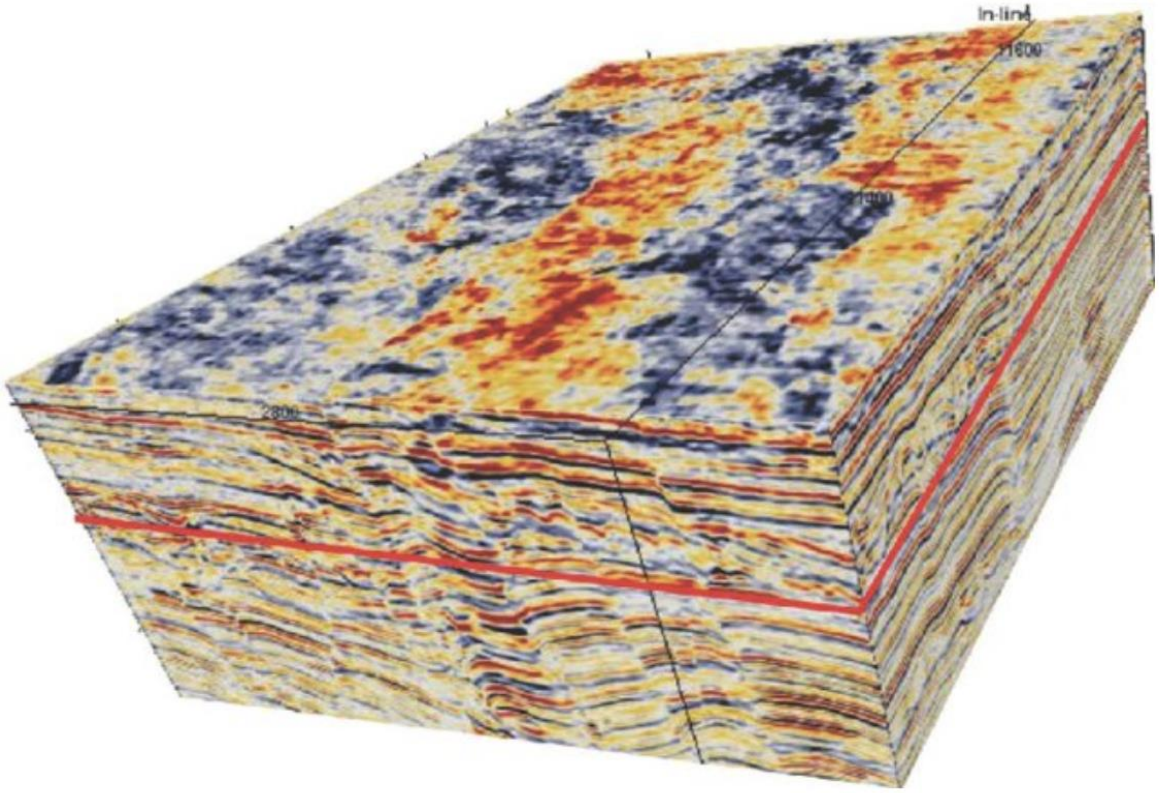
Polarity standard for minimum- and zero-phase wavelets

POSITIVE REFLECTION (i.e. increase of seismic impedance)



Metodo sismico a riflessione: il risultato

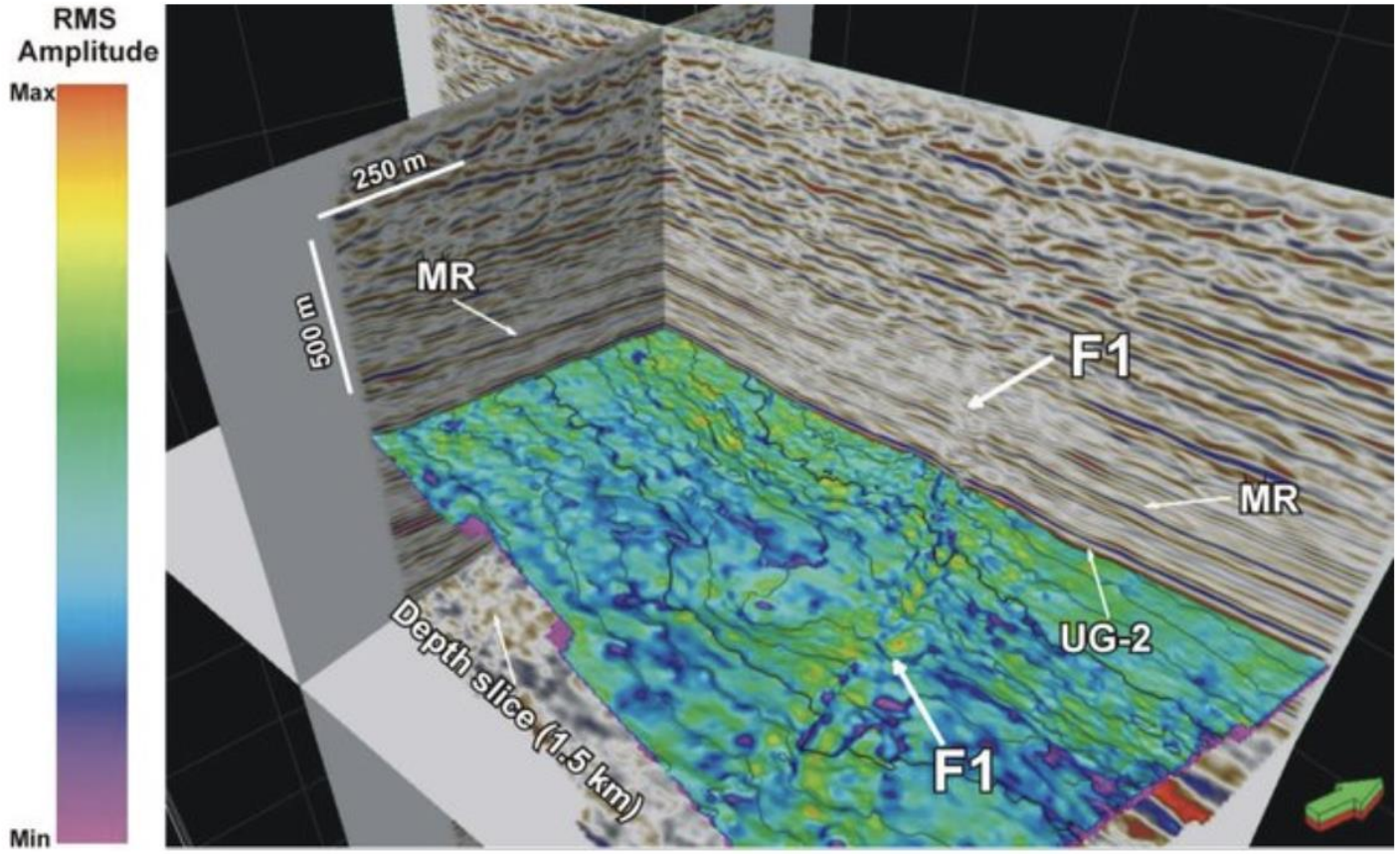
3-D



Volume

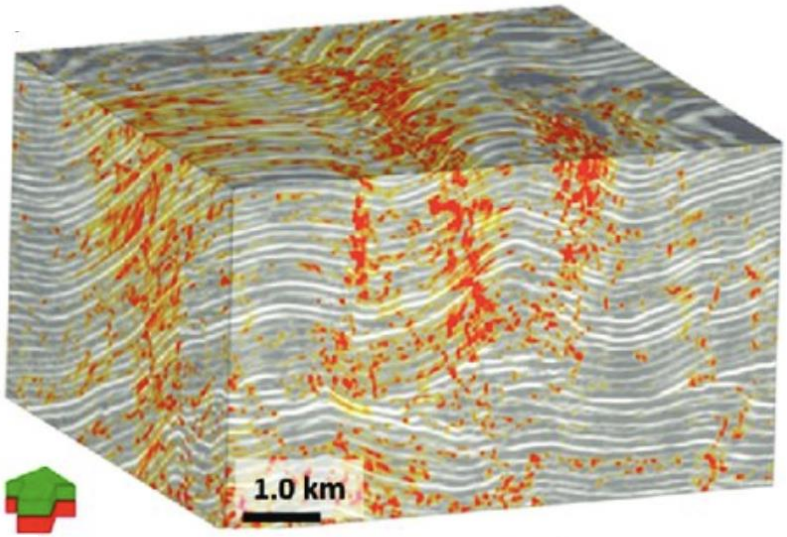
Metodo sismico a riflessione: il risultato

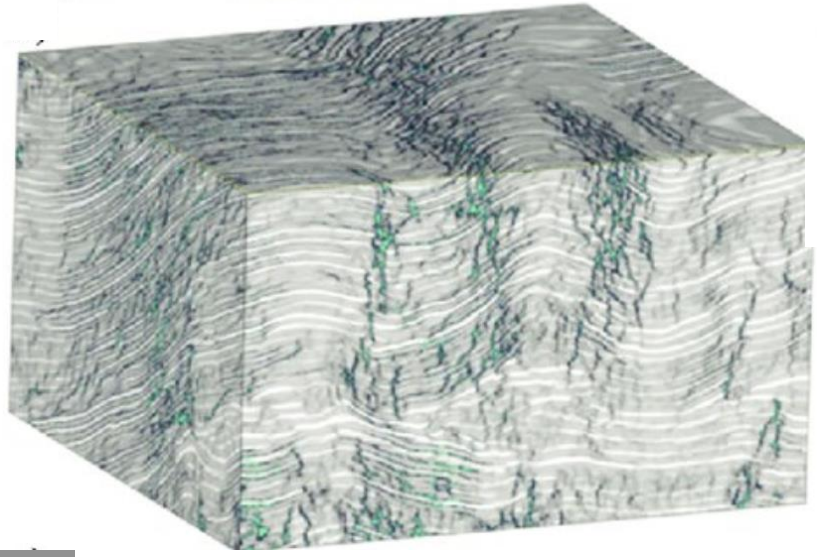
3-D

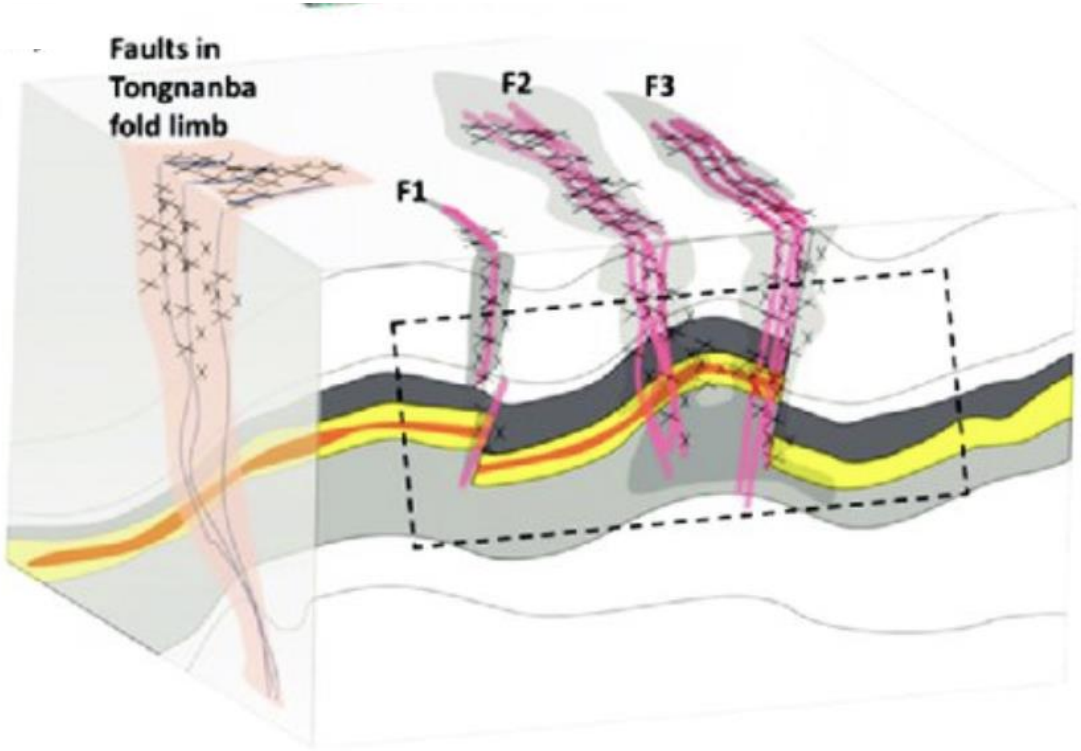


Volume

Metodo sismico a riflessione: l'interpretazione







Metodo sismico a riflessione: SORGENTI

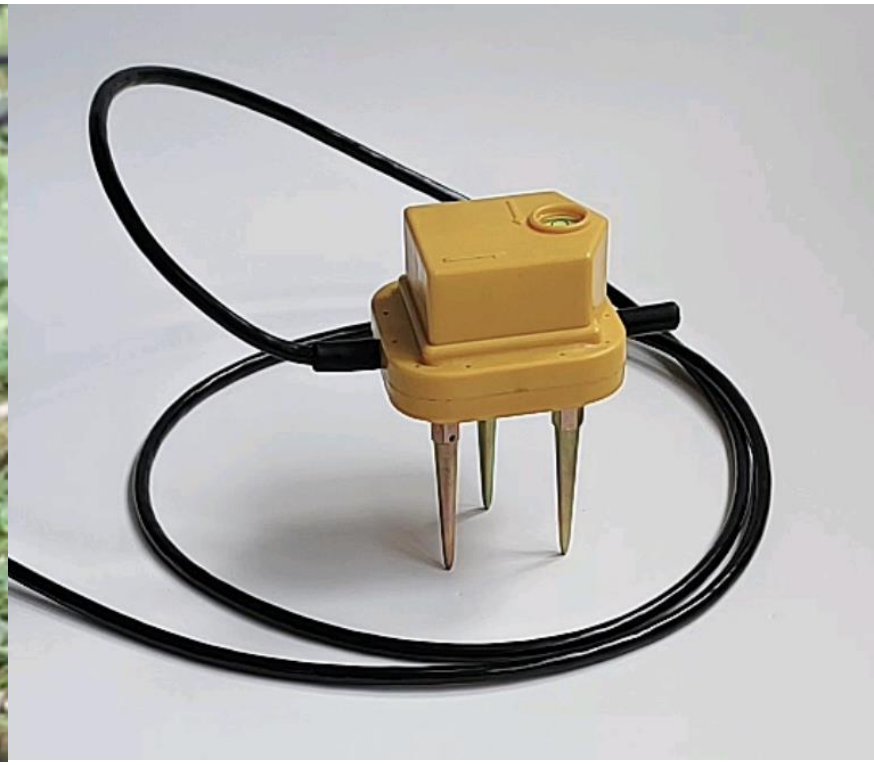
Metodo sismico a riflessione: SORGENTI

AIR-GUN

AIR-GUN ARRAY

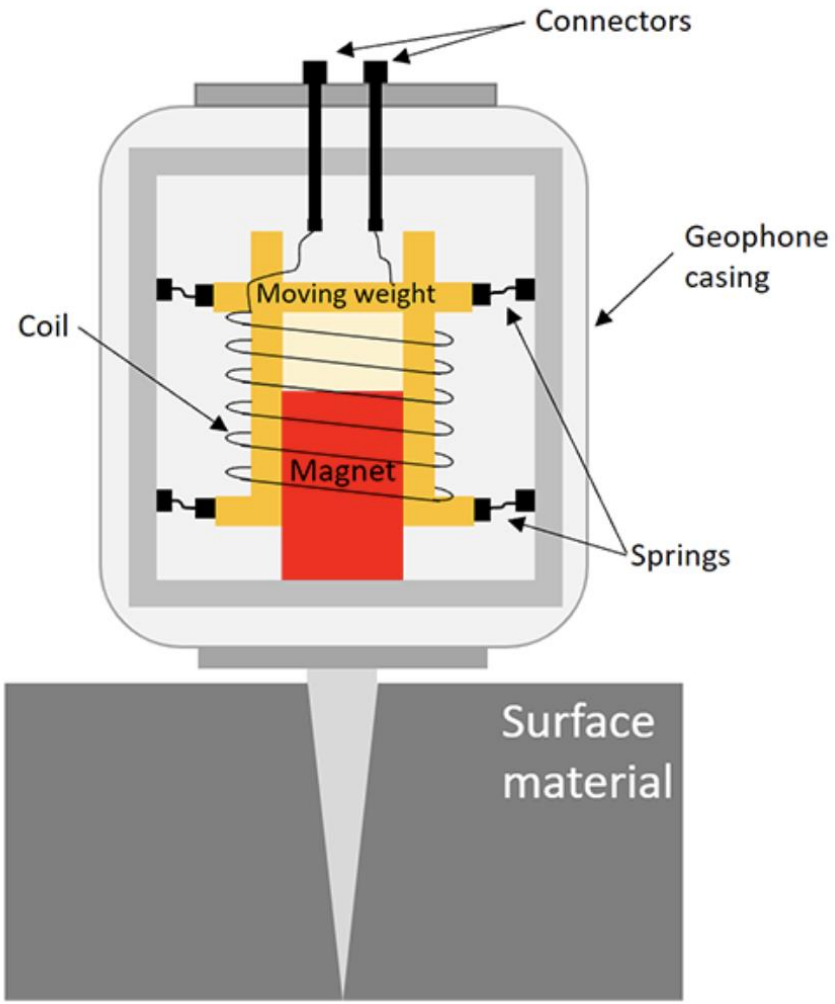
Metodo sismico a riflessione: sensori

Geofoni



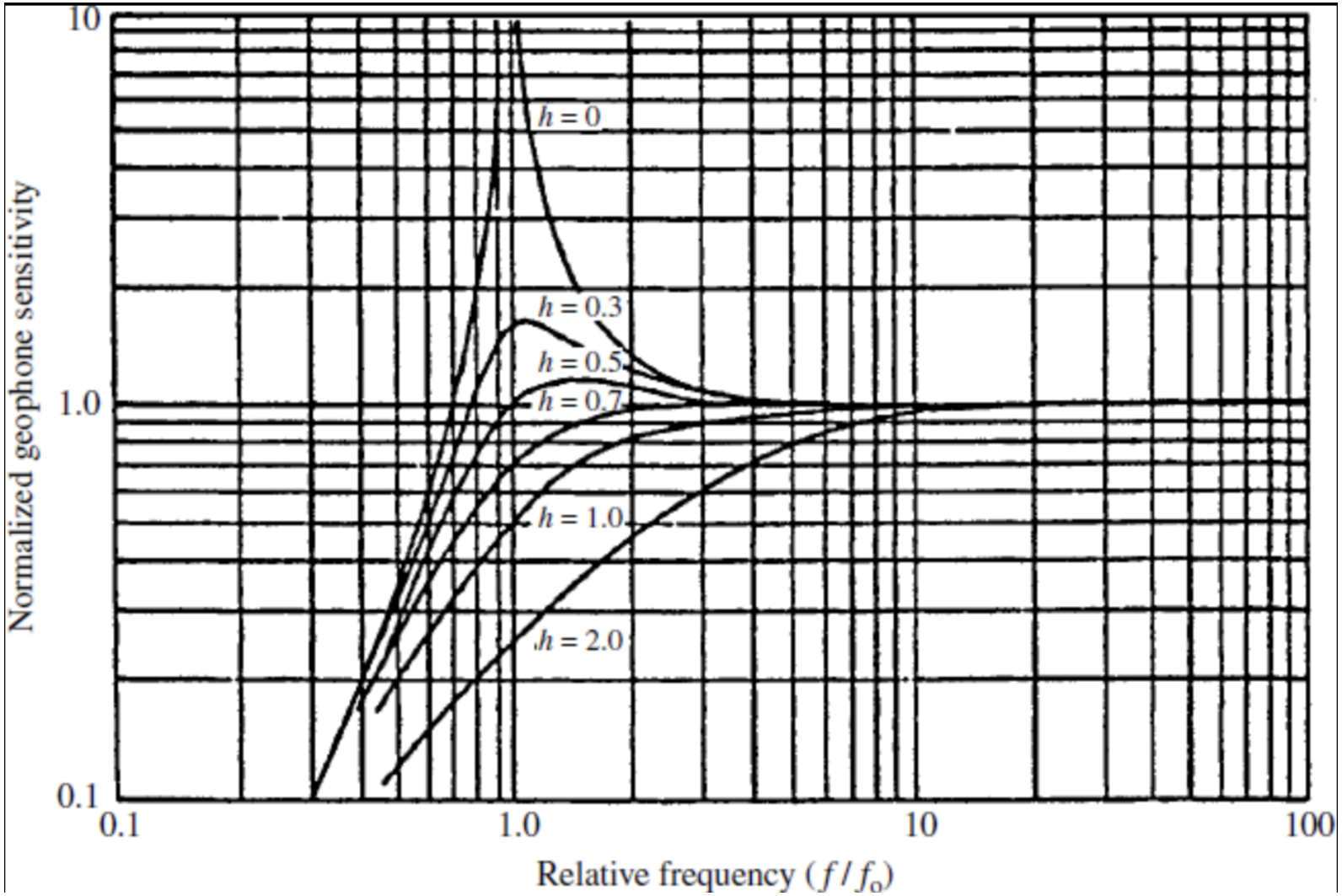
Metodo sismico a riflessione: sensori

Geofoni



Metodo sismico a riflessione: sensori

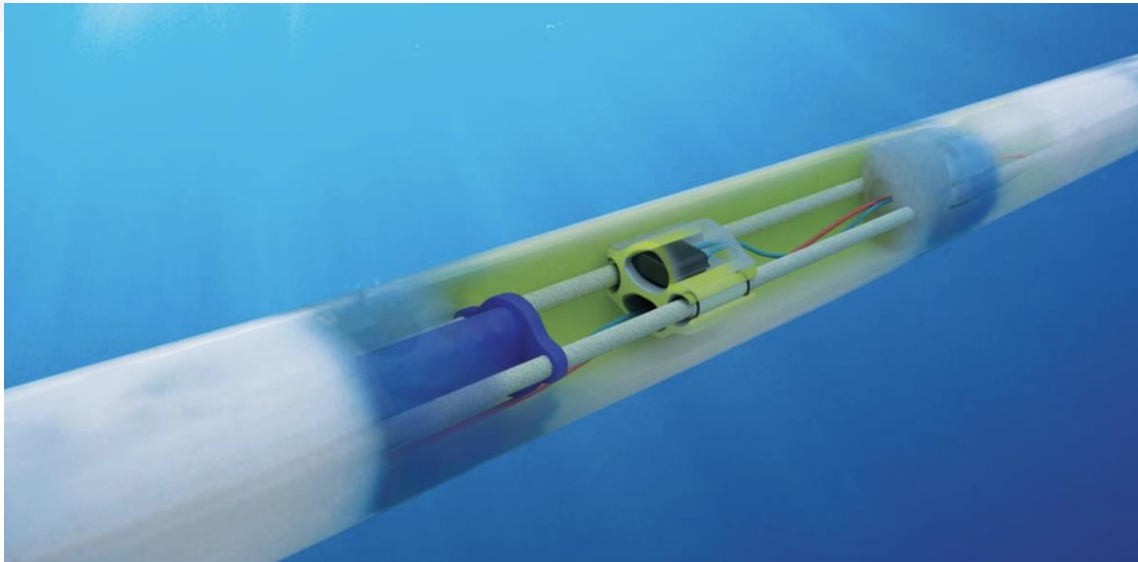
Geofoni: curva di risposta



Metodo sismico a riflessione: sensori

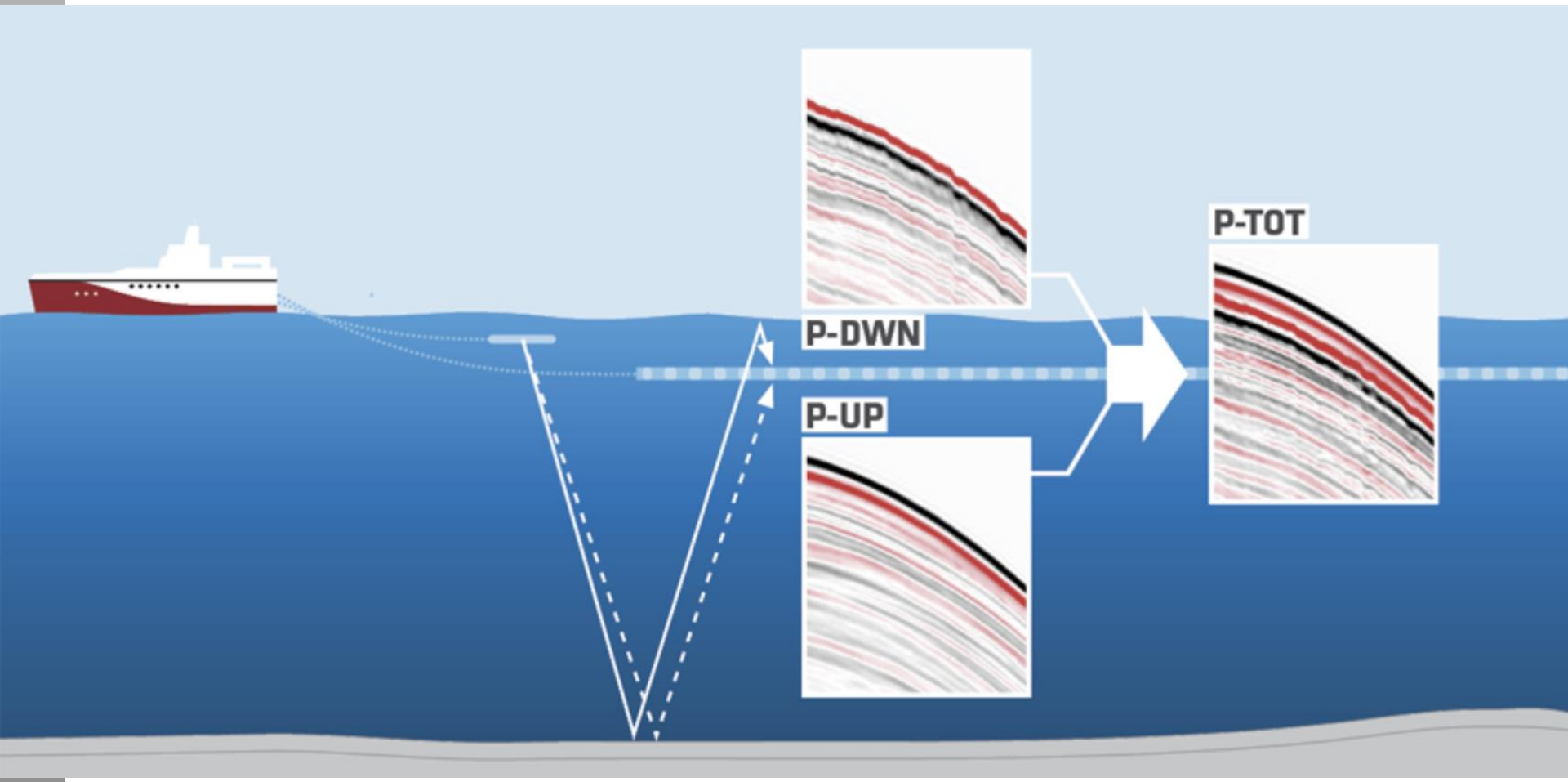
Idrofoni

Seismic streamer



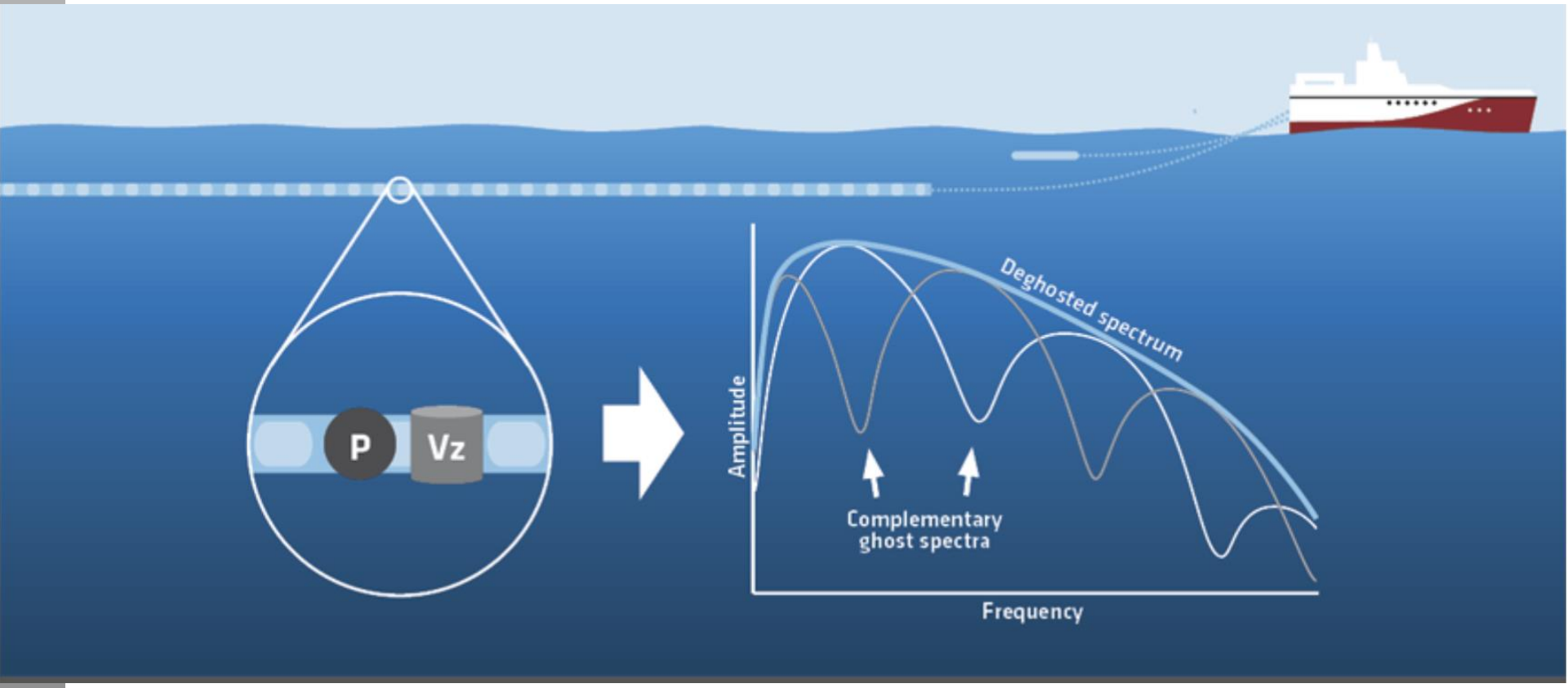
Metodo sismico a riflessione: sensori

Dual sensors



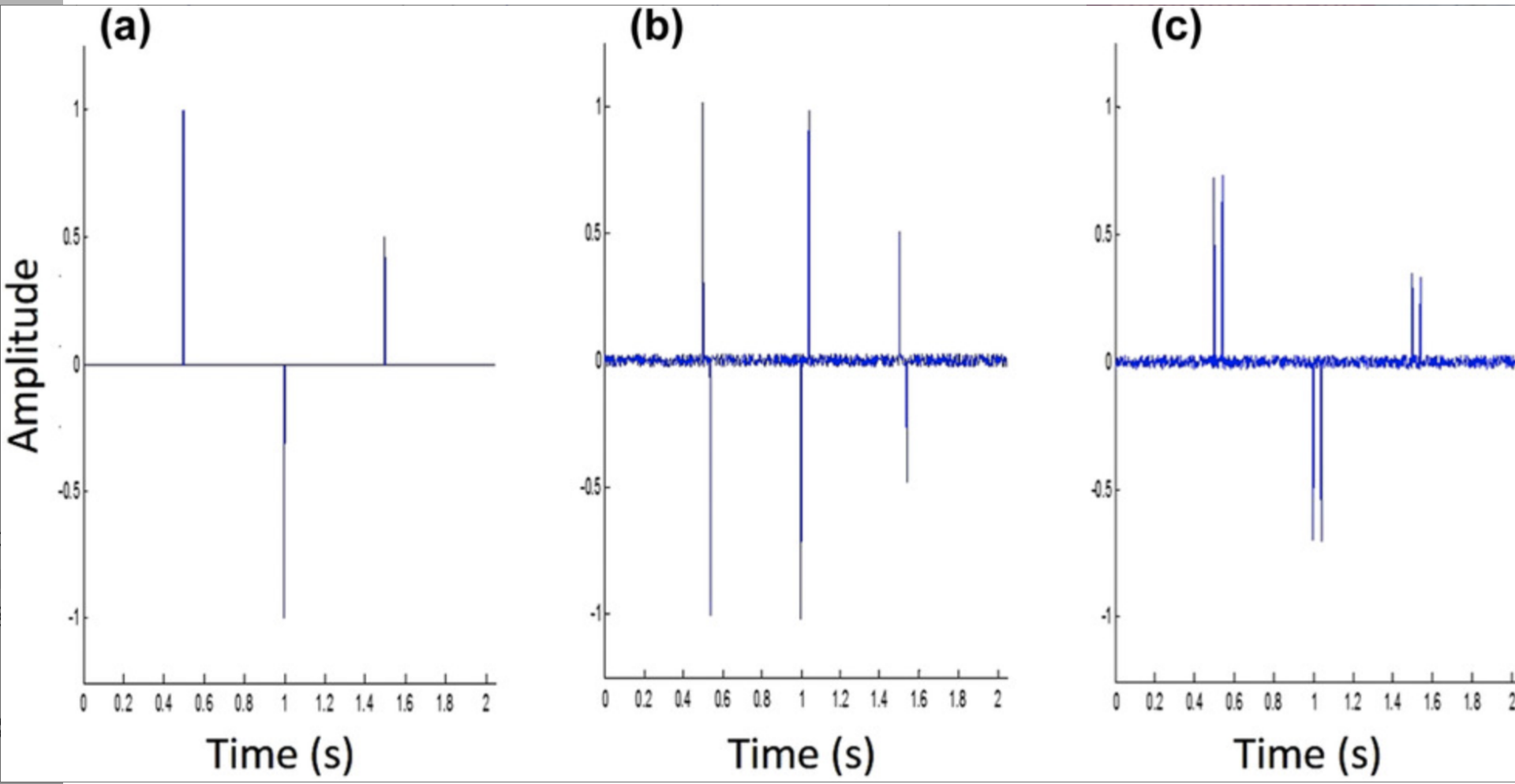
Metodo sismico a riflessione: sensori

Dual sensors

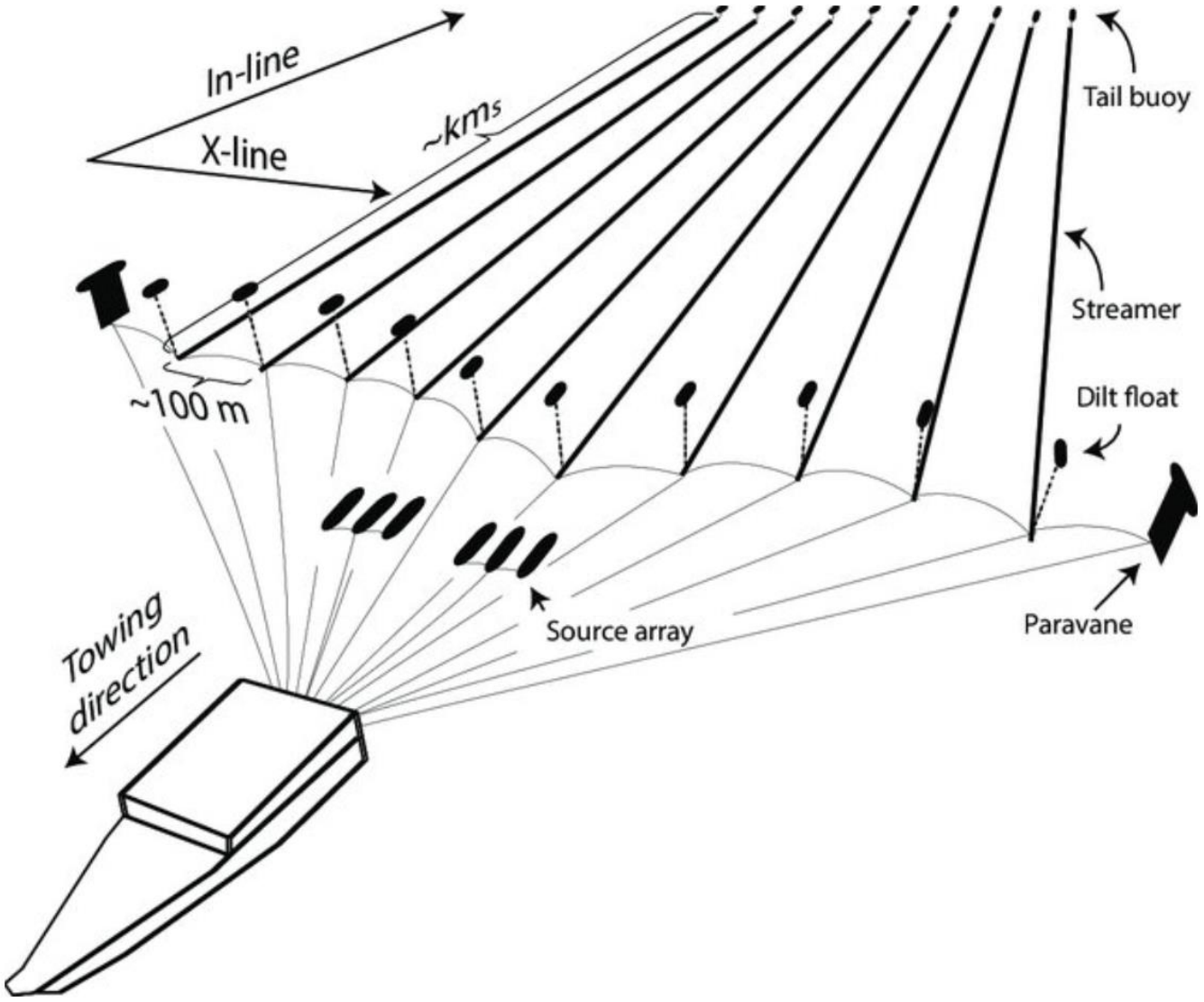


Metodo sismico a riflessione: sensori

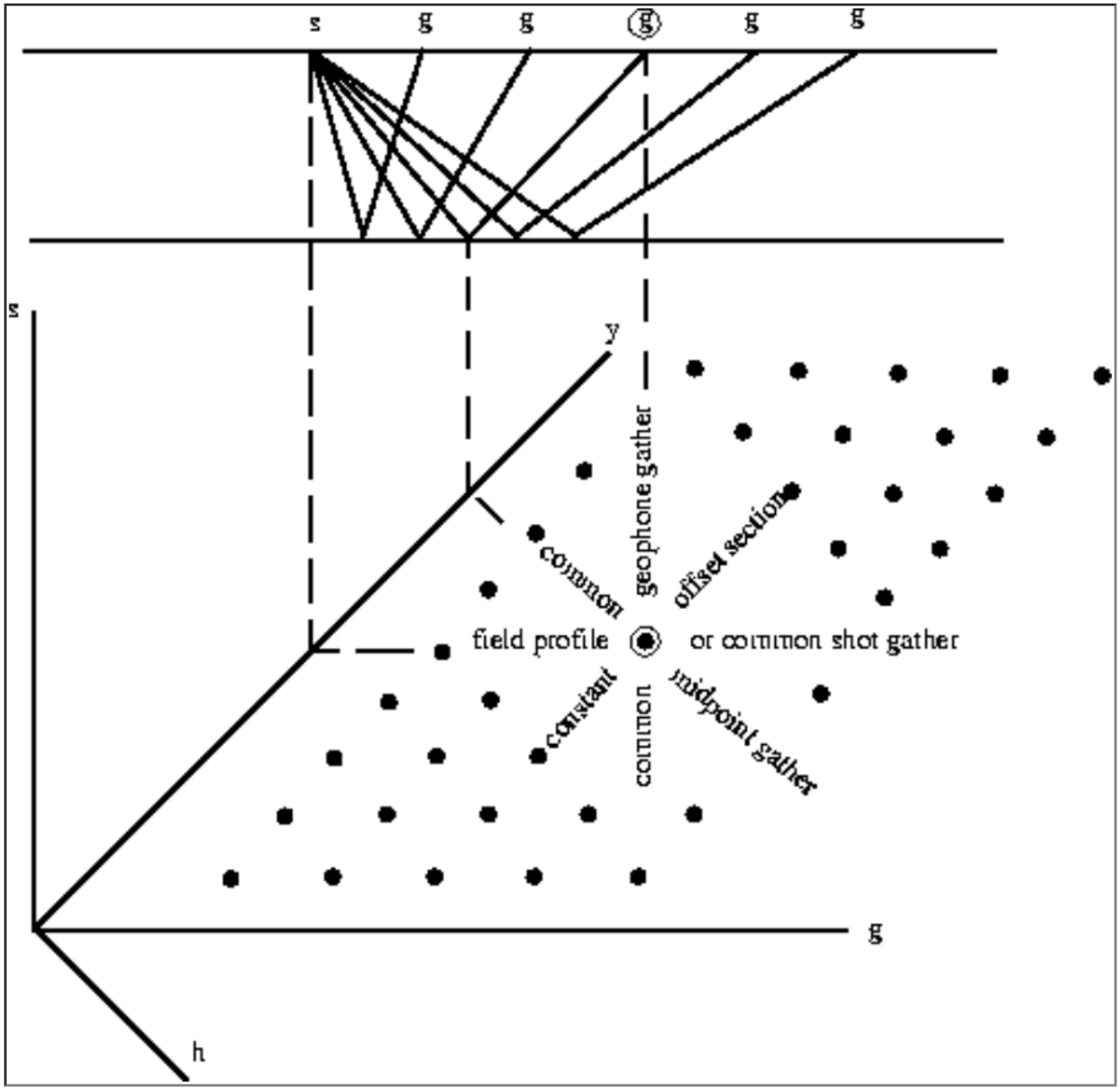
Dual sensors



Metodo sismico a riflessione: acquisizione marina



Metodo sismico a riflessione: stacking chart



Metodo sismico a riflessione: acquisizione marina