



# INTERPRETATION OF SEISMIC REFLECTION

(cod.: "950 SM")

Course for

Laurea Magistrale in Geoscienze

teacher: Anna Del Ben

A.A. 2020-21

# INTERPRETAZIONE di DATI SISMICI a RIFLESSIONE

- Orario del corso: Martedì 9,00-11,00  
Giovedì 9,00-11,00
- Organizzazione del corso: 4 CFU lezioni frontali/su piattaforma digitale  
2 CFU esercitazioni
- Contributi da personale esterno: esperti OGS et al.
- Reperibilità per chiarimenti e spiegazioni:  
11,00-13,00 martedì e giovedì  
temporaneamente via e-mail
- Modalità d'esame: esame orale (interpretazione e discussione di un profilo sismico, relazione sul lavoro fatto durante le esercitazioni, contenuti teorici del corso)  
*data da concordare*
- Contenuti del corso ...
- Bibliografia ...

# CONTENUTI SINTETICI DEL CORSO

- **DATI DISPONIBILI** in rete: Progetti ViDEPI e Virtual Seismic Atlas
- **ASSUNZIONI GEOFISICHE DI BASE:** Onde Riflesse e Rifratte, Legge di Snell, Iperbole di Riflessione, Principio di Huygens, Coefficiente di riflessione, Sismogrammi sintetici, Dati sismici *stack* e migrati, Costanti Elastiche, Risoluzione verticale, Risoluzione orizzontale, Fenomeni di *Tuning*
- **DISTURBI PRESENTI** nel DATO SISMICO : Multiple, Diffrazioni , Effetti di orizzonti pendenti, Effetti della Migrazione, *Pull-up* e *pull-down velocity* e conversione/migrazione in profondità di dati sismici
- **COLLEZIONE ED ANALISI DI DATI SISMICI** : Linee sismiche regionali, Maglia linee sismiche e loro Intersezioni, Attributi Sismici, Sismica 3-D e 4-D, *Time Lapse*, Sismica 4C
- **TARATURA CON POZZI** : Utilizzo di pozzi stratigrafici per l'interpretazione sismica, *Sonic log*, etc
- **SISMOSTRATIGRAFIA** : *Unconformities*, Facies sismiche e modelli deposizionali , *Sequence* e *Seismic stratigraphy*, *System Tracts*, etc
- RICONOSCIMENTO SISMICO DI STRUTTURE DI **REEF, MARGINI DI PIATTAFORMA, PIATTAFORME ISOLATE**
- RICONOSCIMENTO E INTERPRETAZIONE SISMICA DI **PROCESSI HALOCINETICI**
- RICONOSCIMENTO DI **FAGLIE** E STILI TETTONICO-STRUTTURALI : Faglie normali, inverse e sistemi trascorrenti, Ricostruire il pattern delle faglie
- **SISMICA CROSTALE:** Caratteristiche sismiche di crosta continentale e oceanica , Progetti di Sismica Crostale (CROP, etc)
- INDICATORI SISMICI DELLA **PRESENZA DI FLUIDI** : *Bright*, *Dim* e *Flat spots*, Analisi di Porosità e Permeabilità,
- **SEMINARI** da parte di ESPERTI su *Bottom Simulating Reflector* (BSR), Stoccaggio CO<sub>2</sub>, etc
- **ESERCITAZIONI** con software Petrel: Picking di riflettori, Conversione in profondità, Mappatura di orizzonti e mappe isopache , Sezioni cronostatigrafiche, *Case history*

# BIBLIOGRAPHY

- Lines and Newrick - **FUNDAMENTALS OF GEOPHYSICAL INTERPRETATION**
- Herron – **FIRST STEP IN SEISMIC INTERPRETATION**
- Yilmaz - **SEISMIC DATA ANALYSIS**
- Lindseth - **DIGITAL PROCESSING OF GEOPHYSICAL DATA - A REVIEW**
- Sheriff and Geldart - **EXPLORATION SEISMOLOGY**
- Anstey - **SEISMIC INTERPRETATION - The Physical Aspects**
- Avseth et al. - **QUANTITATIVE SEISMIC INTERPRETATION**
- Shaw, Connors and Suppe – **SEISMIC INTERPRETATION OF CONTRACTIONAL FAULT- RELATED FOLDS, AAPG Seismic Atlas, Studies in Geology, 53**
- AAPG Mem.26 - **SEISMIC STRATIGRAPHY - Application to Hydrocarbon Exploration**
- Emery and Myers - **SEQUENCE STRATIGRAPHY**
- Davies, Posamentier, Wood and Cartwright – **SEISMIC GEOMORPHOLOGY Application to Hydrocarbon Exploration and Production Geol. Soc. Sp. Publ., N.277**

# Interpretation of Seismic Reflection

- It is fundamental in the research applied to the geoscience;
- It furnishes information about:
  - geometries of stratigraphic sequences, structural and tectonic features,
  - seismic velocities,
  - lithological characteristics;
- It gives a **geological meaning** to geophysical data, practically it represents a **geophysical inversion**.

*Interpretation is telling the geologic story contained in seismic data. It is correlating the features we see in seismic data with elements of geology as we know them. The story is read from a book having many chapters, some of which are either illegible or unintelligible, and others are lost or yet to be written. And although the story doesn't always have a happy ending, only in its telling do we expand our knowledge.*

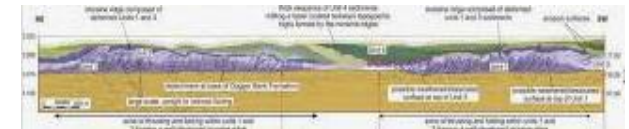
—Interpreter Sam

- Interpretation should be **CONSISTENT** with the available (geological and geophysical) data → (constraints matter)  
 “Seismology is a subset of geophysics”.....

- It is useful to reconstruction of:  
 2D sections, structural maps, fault systems, *slumping* and *seismic hazard*, retrodeformation, subsurface exploration for mineral and hydrocarbon research.

- Ideal interpreter:  
*team* of geologists/geophysicists/physicists with different skills that works in synergy. ...*human intervention and computer HW and SW*” (Lines and Newrick, 2004)  
 Furthermore: “Interpretation is a combination of both **art and science**”

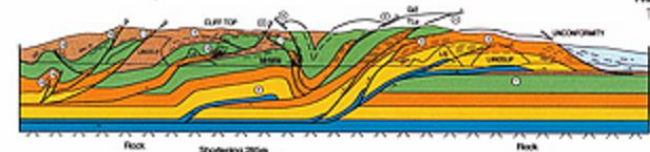
## SEISMIC DATA ANALYSIS



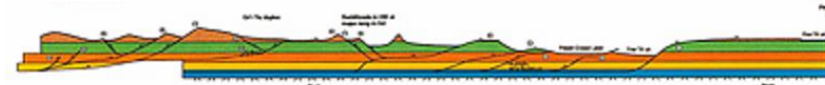
## INTERPRETATION



## BALANCING



## RETRO-DEFORMATION



# Web sites

## Seismic Data and Knowledge Deepening

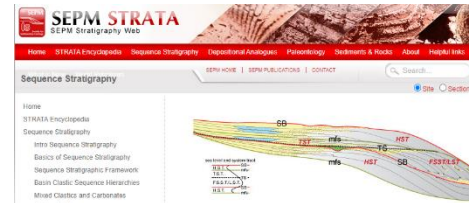
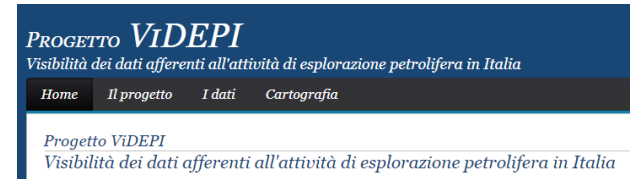
- Seismic profiles and calibration wells

-Banca Dati ViDEPI: <http://www.videpi.com/videpi/videpi.asp>

-Virtual Seismic Atlas: <http://www.seismicatlas.org/>

- Seismostratigraphy

<http://sepmstrata.org/page.aspx?pageid=1>



- Halokinetic tectonics

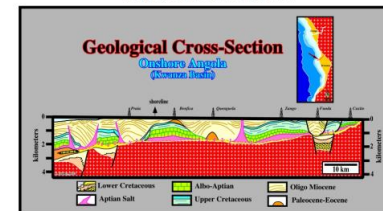
<http://homepage.ufp.pt/biblioteca/>

[SaltTectonics/WebSaltTectonics/Index.htm](http://SaltTectonics/WebSaltTectonics/Index.htm)

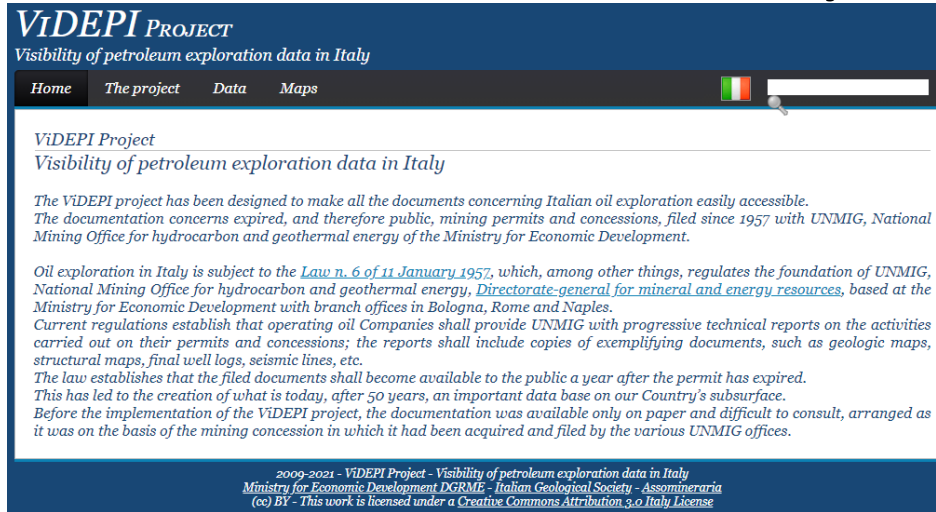
Porto, Portugal



This is the Home Page of the short course "Salt Tectonics". If you click on the interlinks (underlined text and bet), you can navigate and you will find a text and the majority of the plates shown during the course.



# ViDEPI Project



- Open Google Earth on your PC
- From a search engine get to the ViDEPI project site
- Click on “Maps” and then “Download KML files”
- Click on “1. Reconnaissance seismic campaigns of the offshore areas” and then on the bar at the bottom of the downloaded link: Google Earth will open with the positions of all the seismic profiles relating to
- Same procedure for CROP and other profiles (points 2, 3, 4) and wells (point 5 plus bar).
- Clicking on a profile or well, you can select to see the corresponding pdf file

## KML files

### 1. Reconnaissance seismic campaigns of the offshore areas

- o [Zona B](#)
- o [Zona C](#)
- o [Zona D](#)
- o [Zona E](#)
- o [Zona F](#)
- o [Zona G](#)

### 2. CROP Atlas Project, seismic reflection profiles of the Italian crust

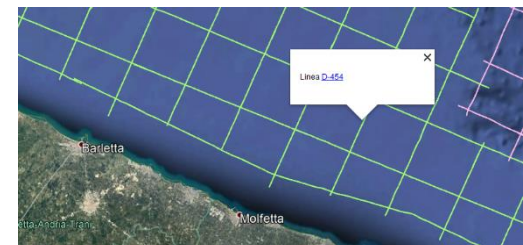
### 3. Seismic lines acquired in expired mining permits and concessions

### 4. Expired mining permits and concessions

### 5. Wells



Note that wells can be partially evidenced in time with the top left bar in Google Earth



# ViDEPI PROJECT

Visibility of petroleum exploration data in Italy

Home The project Data Maps

## ViDEPI Project Visibility of petroleum exploration data in Italy

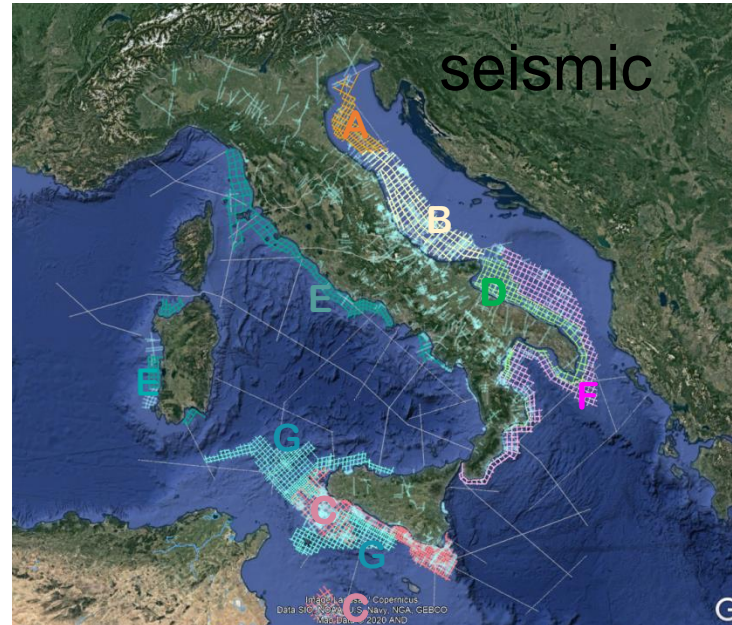
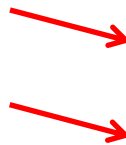
The ViDEPI project has been designed to make all the documents concerning Italian oil exploration easily accessible. The documentation concerns expired, and therefore public, mining permits and concessions, filed since 1957 with UNMIG, National Mining Office for hydrocarbon and geothermal energy of the Ministry for Economic Development.

Oil exploration in Italy is subject to the [Law n. 6 of 11 January 1957](#), which, among other things, regulates the foundation of UNMIG, National Mining Office for hydrocarbon and geothermal energy, [Directorate-general for mineral and energy resources](#), based at the Ministry for Economic Development with branch offices in Bologna, Rome and Naples.

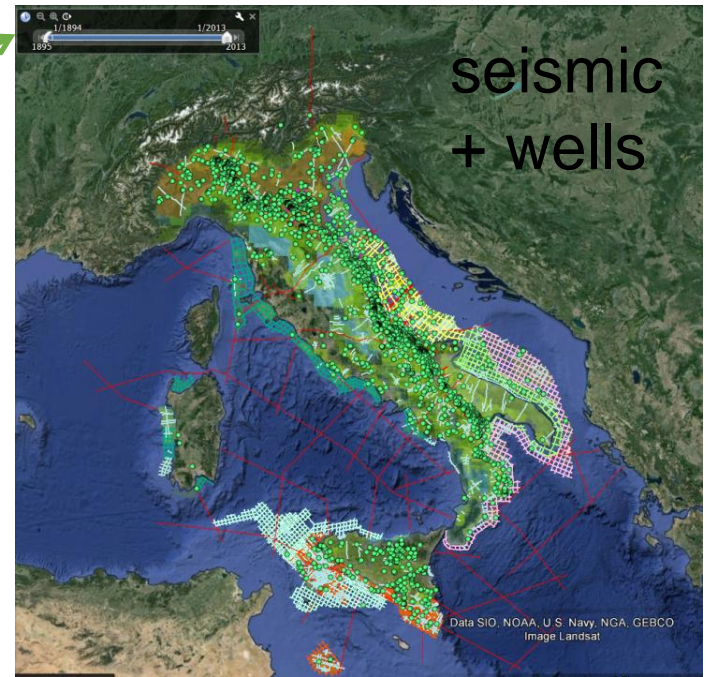
Current regulations establish that operating oil Companies shall provide UNMIG with progressive technical reports on the activities carried out on their permits and concessions; the reports shall include copies of exempting documents, such as geologic maps, structural maps, final well logs, seismic lines, etc.

The law establishes that the filed documents shall become available to the public a year after the permit has expired. This has led to the creation of what is today, after 50 years, an important data base on our Country's subsurface. Before the implementation of the ViDEPI project, the documentation was available only on paper and difficult to consult, arranged as it was on the basis of the mining concession in which it had been acquired and filed by the various UNMIG offices.

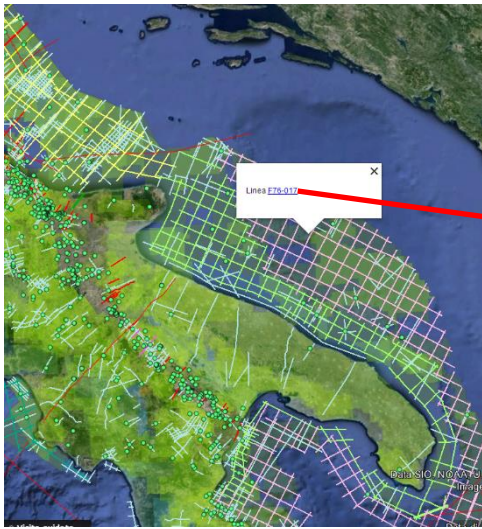
2009-2021 - ViDEPI Project - Visibility of petroleum exploration data in Italy  
Ministry for Economic Development DGRME - Italian Geological Society - Assomineraria  
(cc) BY - This work is licensed under a Creative Commons Attribution 3.0 Italy License



With this bar position of the wells will be evidenced on the base of their drilling age







**PROGETTO VIDEPI**  
 Visibilità dei dati afferenti all'attività di esplorazione petrolifera in Italia

Home Il progetto I dati Cartografia

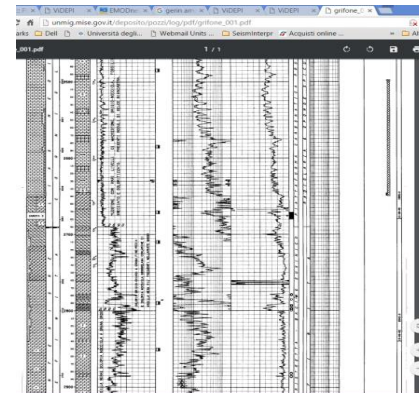
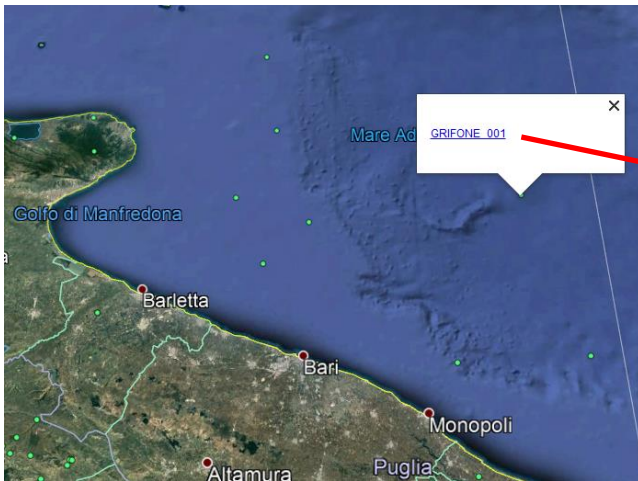
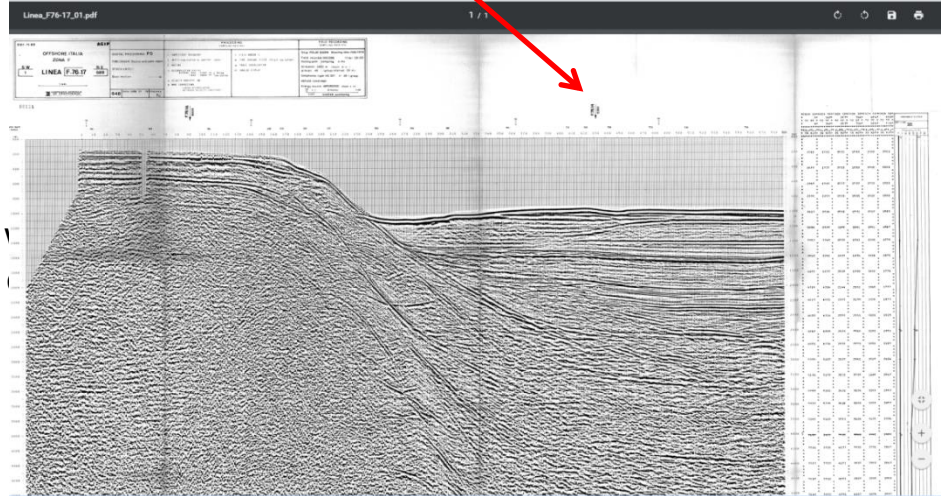
Linee sismiche  
 Sismica riconosciuta ZONA F  
 Linea F76-017  
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1. [Linea F76-17\\_01](#) (2.458 Kb)
2. [Linea F76-17\\_02](#) (1.586 Kb)
3. [Linea F76-17\\_03](#) (1.433 Kb)
4. [Linea F76-17\\_04](#) (1.720 Kb)
5. [Linea F76-17\\_05](#) (1.679 Kb)

[Visualizza in Google Maps](#)  
 La visualizzazione in Google Maps ha soltanto valore indicativo

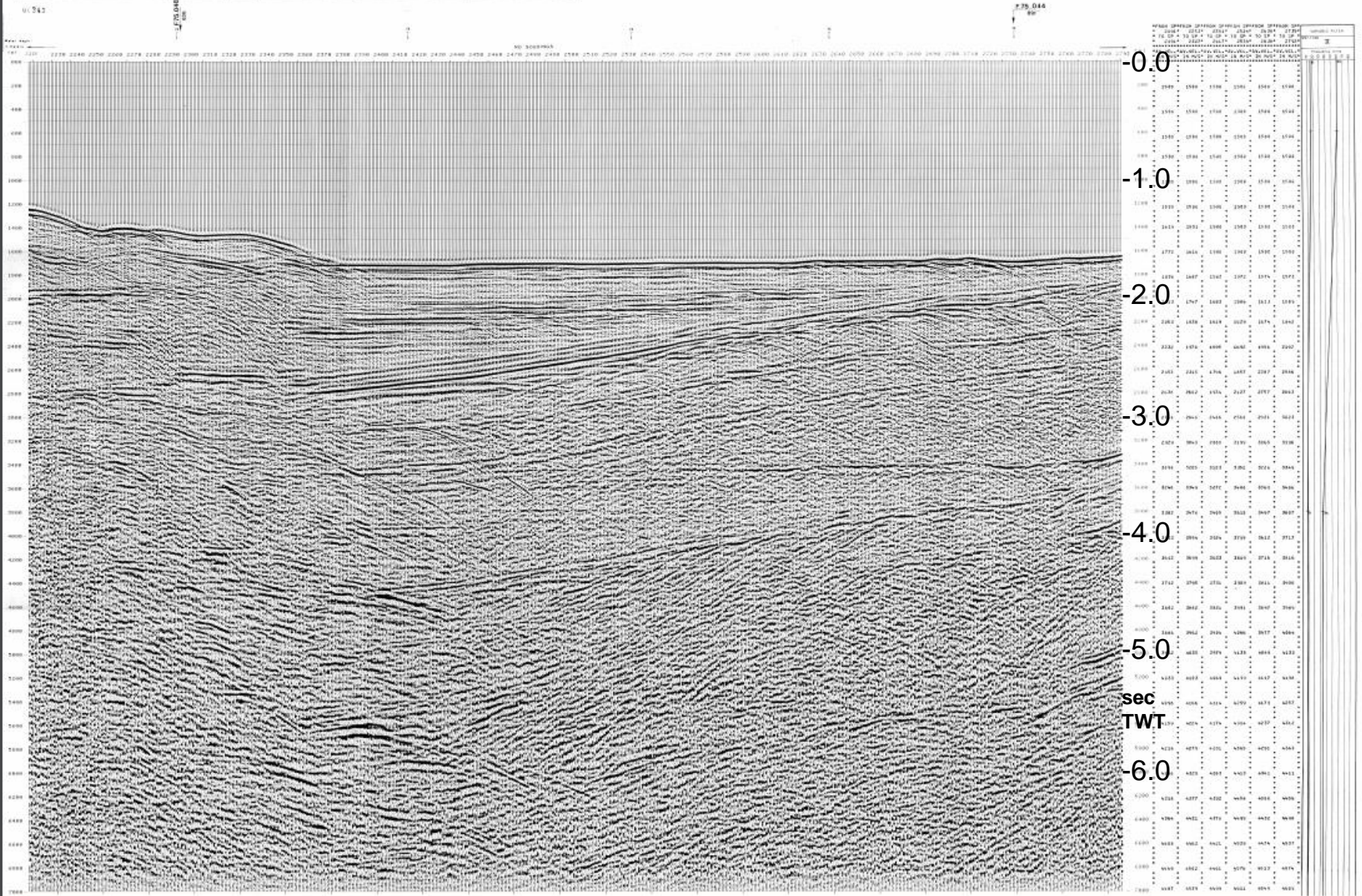
**Nota:**  
 I file immagine delle linee sismiche sono in formato raster e pertanto la loro visualizzazione richiede il download completo del file pdf, con tempi di attesa che a volte possono essere lunghi.

Click on the name of a profile or  
 A link to the file or more files will  
 to the pdf files.



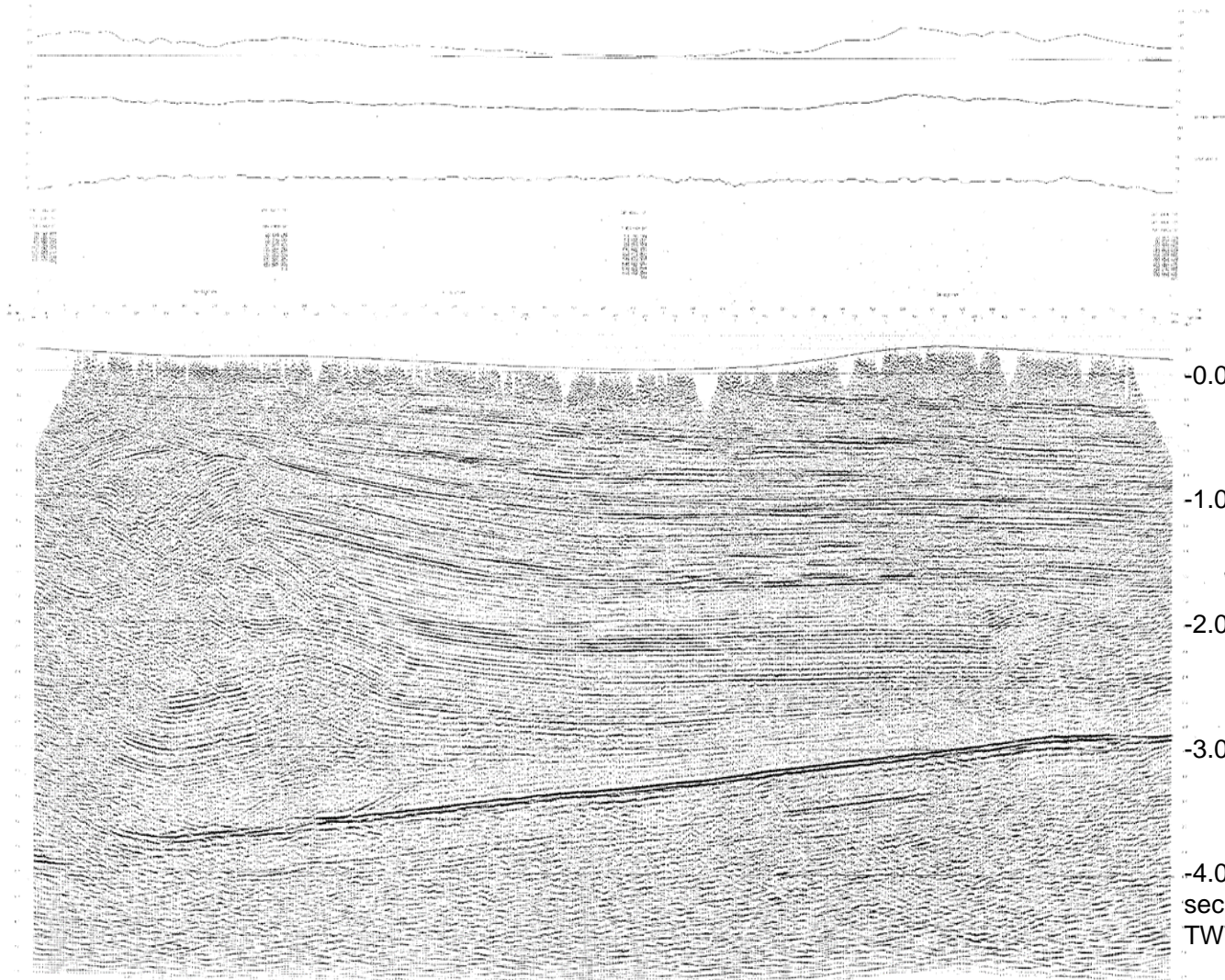
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# Profile in the sea



**PEF-08-87**

**Profile in the onland**



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