

# OCEANOGRAFIA E GEOFISICA PER LE SCIENZE DELLA TERRA

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Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS





## Our mission

OGS è un Ente Pubblico di Ricerca a vocazione internazionale che trae le sue origini dalla Scuola di Astronomia e Navigazione istituita a Trieste nel 1753 dall'Imperatrice Maria Teresa d'Austria.





# Enti Pubblici di Ricerca vigilati dal Miur

1. Area di Ricerca Scientifica e Tecnologica di Trieste - Area Science Park;
2. Agenzia Spaziale Italiana - ASI;
3. Consiglio Nazionale delle Ricerche - CNR;
4. Istituto Italiano di Studi Germanici;
5. Istituto Nazionale di Astrofisica - INAF;
6. Istituto Nazionale di Alta Matematica "Francesco Severi" - INDAM;
7. Istituto Nazionale di Fisica Nucleare - INFN;
8. Istituto Nazionale di Geofisica e Vulcanologia - INGV;
9. Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS;
10. Istituto Nazionale di Ricerca Metrologica - INRIM;
11. Museo Storico della Fisica e Centro Studi e Ricerche "Enrico Fermi";
12. Stazione Zoologica "Anton Dohrn";
13. Istituto Nazionale per la Valutazione del Sistema Educativo di Istruzione e di Formazione - INVALSI;
14. Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa – INDIRE.

# Trieste città della scienza



INAF  
ISTITUTO NAZIONALE DI ASTROFISICA  
OSSERVATORIO ASTRONOMICO  
DI TRIESTE

cbm  
connecting bio-research and industry

elettra  
Elettra Sincrotrone Trieste

IS

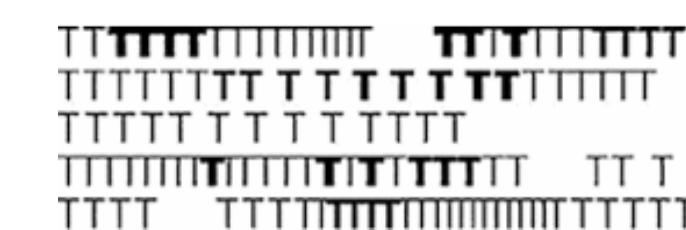
UWC ADRIATIC  
COLLEGIO DEL MONDO UNITO DELL'ADRIATICO O.N.L.U.S.



UNIVERSITÀ  
DEGLI STUDI DI TRIESTE



The Abdus Salam  
International Centre  
for Theoretical Physics



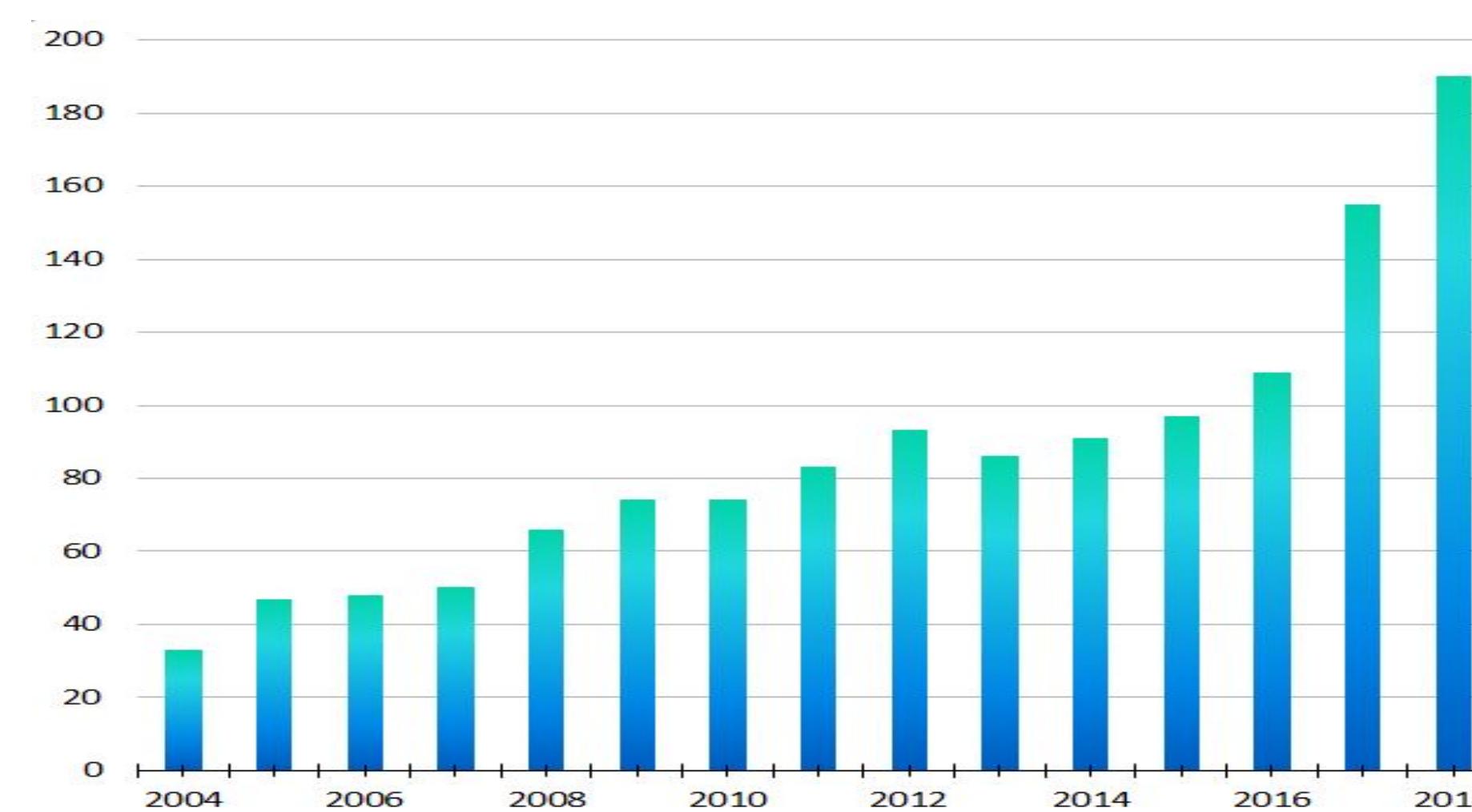
Conservatorio  
di musica  
Giuseppe  
Tartini  
Trieste



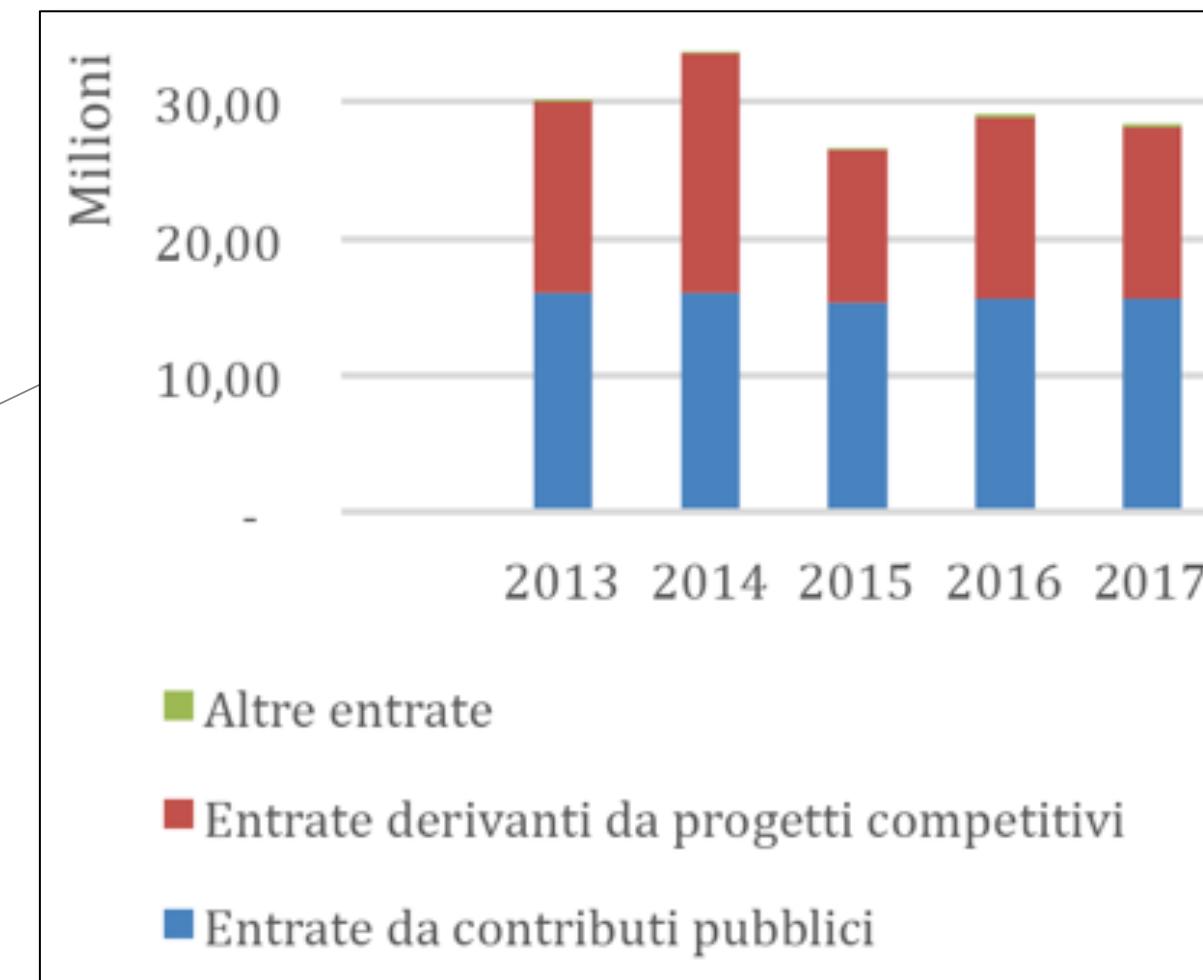
## Ubicazione



## Fonti di finanziamento



Prodotti scientifici  
Fonte Scopus



## Risorse umane



**287** - tra ricercatori, tecnologi, tecnici e personale amministrativo

Circa **40** tra studenti di dottorato e altro personale in formazione

# 4 Sezioni scientifiche e tecnologiche

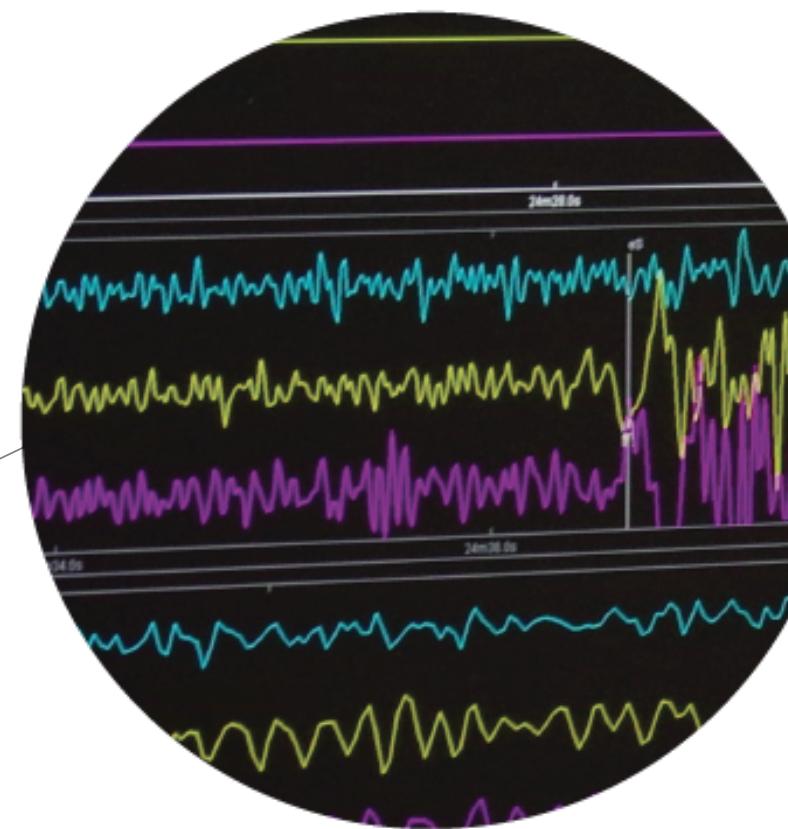
Oceanografia



Geofisica



Sismologia



Infrastrutture



# Priorità geografiche



Centro-Sud America



Area del Mediterraneo



Aree polari

# Il mondo è il nostro laboratorio!



## Tre tipi di attività





### Priorità di ricerca scientifica e tecnologica

1. Svelare ed usare il potenziale dei mari e degli oceani
2. Mitigazione dell'impatto di disastri tra mare e terra
3. Che c'è sotto i nostri piedi: conoscenza ed uso dell'interno della Terra
4. Allargare la comunità di utenti dei dati: rendere i dati ed i prodotti marini FAIR
5. Predire la futura risposta climatica delle regioni polari

### Terza missione

1. Valorizzazione economica della conoscenza, che comprende la ricerca conto terzi, la gestione di proprietà intellettuale, la creazione di imprese e, più in generale, i rapporti ricerca-industria;
2. Produzione di beni pubblici di natura sociale, culturale ed educativa finalizzati ad aumentare il benessere e la resilienza della società.

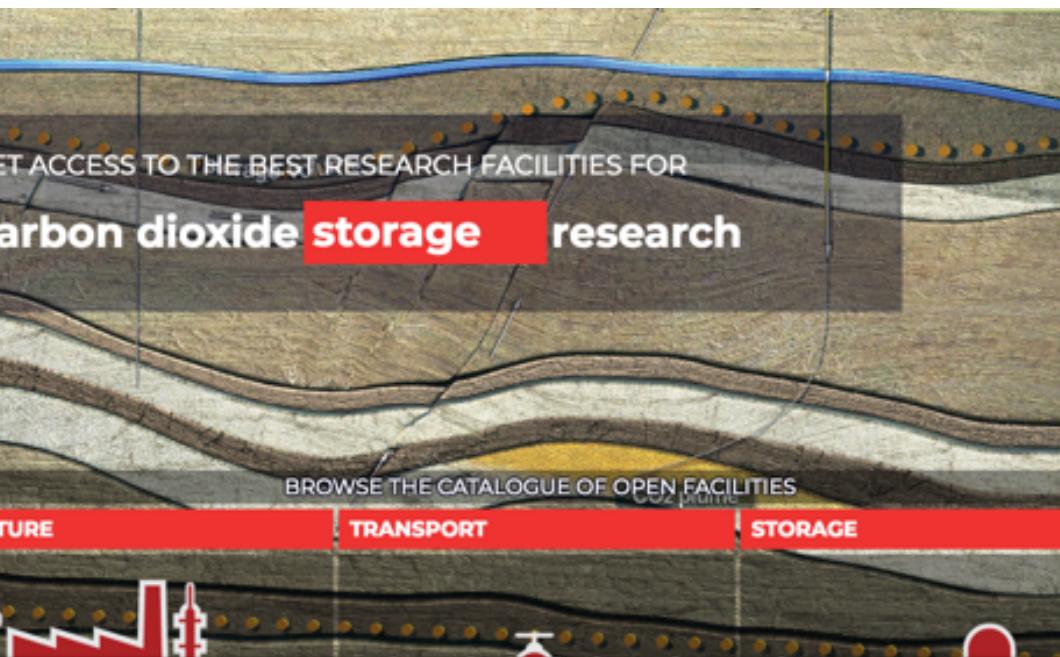
### Ricerca istituzionale

1. Progettazione, realizzazione, gestione e manutenzione di infrastrutture di ricerca di particolare complessità;
2. Creazione e gestione di infrastrutture di ricerca immateriali (banche dati);
3. Attività di alta consulenza.

# Infrastrutture di ricerca ESFRI a coordinamento OGS per l'Italia



<https://www.euro-argo.eu/>

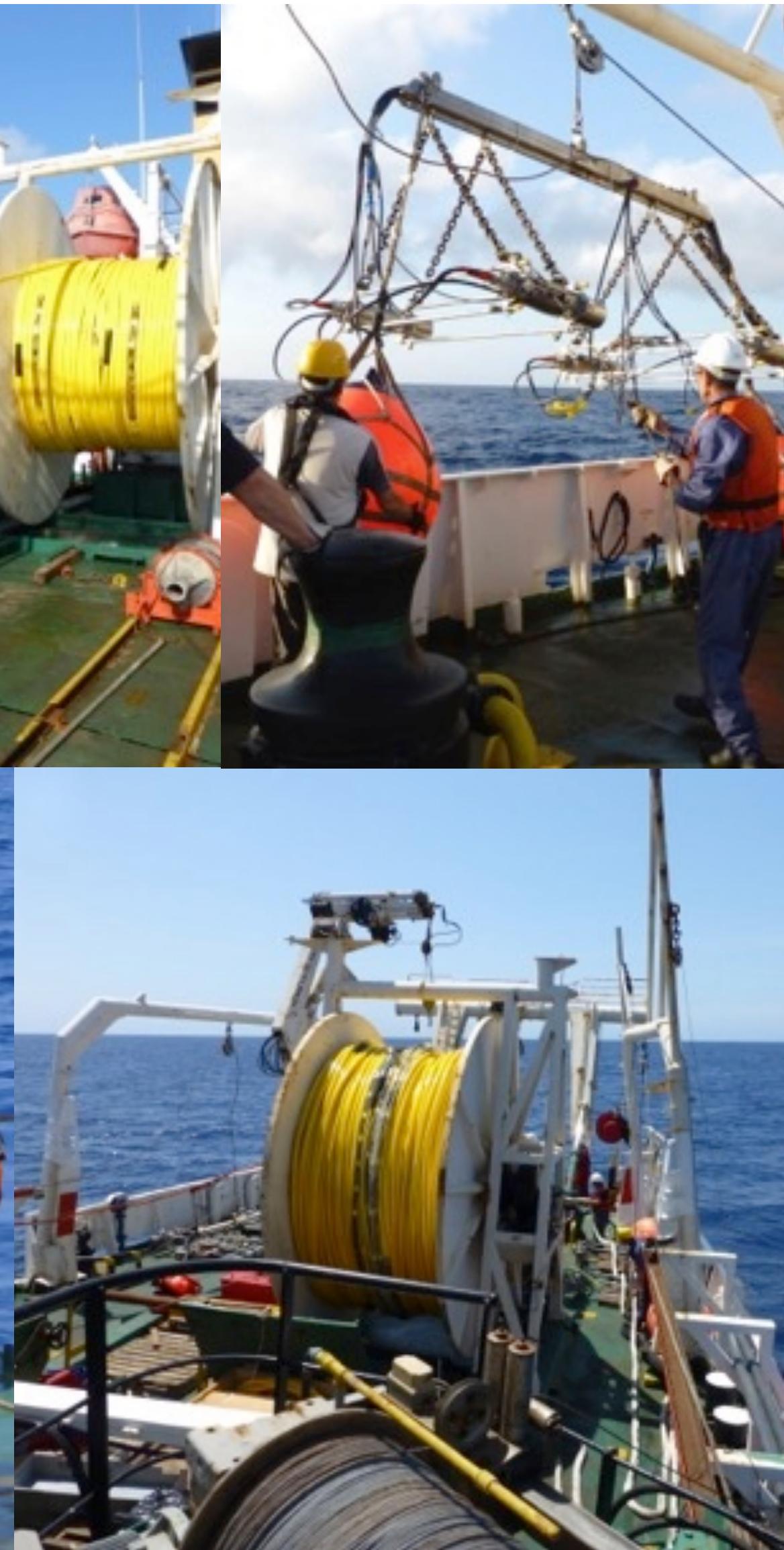


<http://www.eccsel.org/>



<http://www.prace-ri.eu/>

# Infrastrutture di ricerca – R/V OGS Explora



RRS Ernest Shackleton

Excellent logistical facility, can be fit for research

Ice breaker E05

80 m

Crane 50 ton

600 ton cargo

300 mc fuel Jen A1

70 persons

DP2

12 Millions



- **Borehole Geophysics**
- **Geosciences**
- **Geophysical Integrated Analysis and New Technologies**

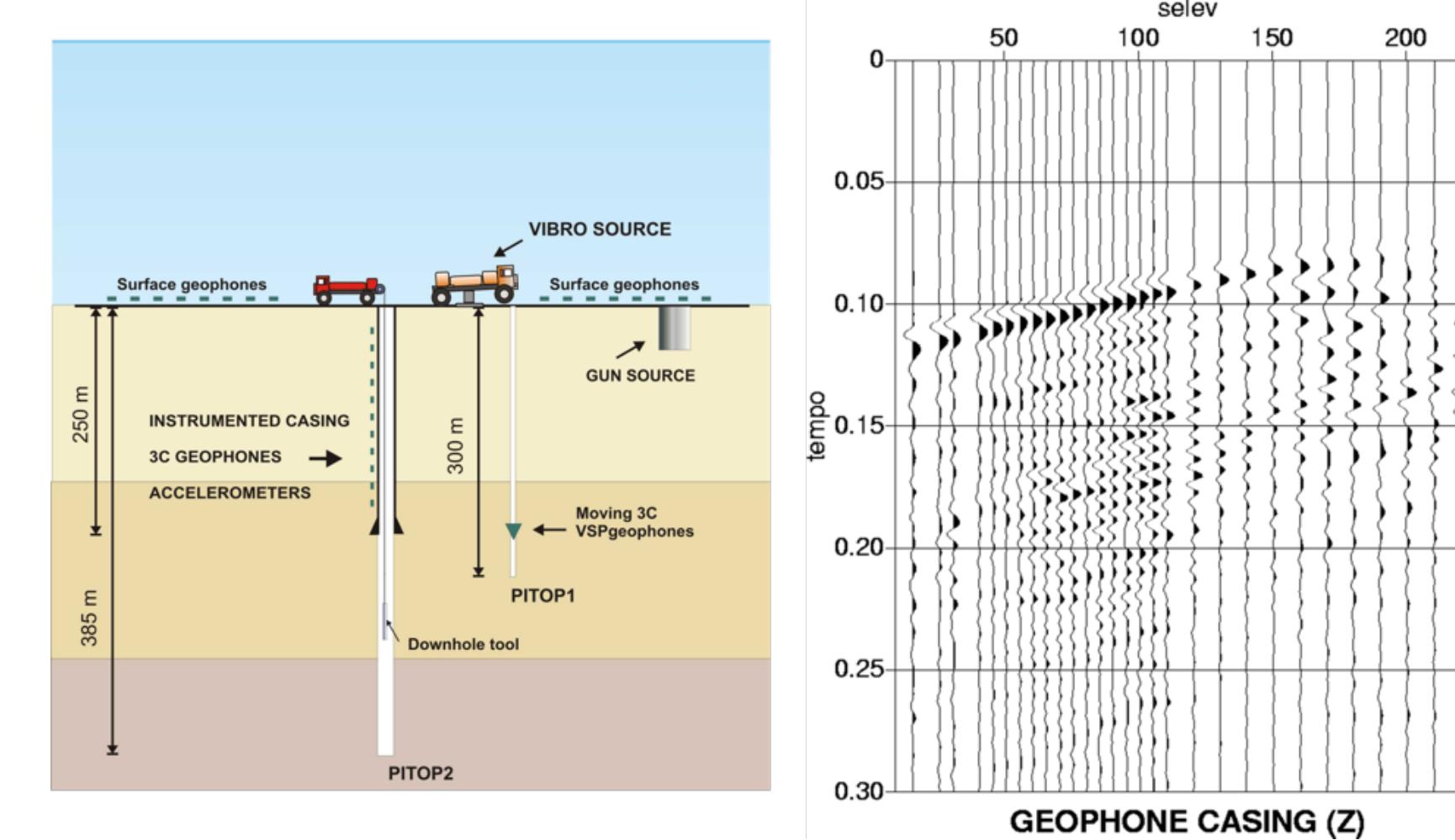
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- 22 researchers (Physics, Mathematics, Geophysics, Geology)
- 10 engineers
- 6 technicians
- 2 administrative support
- 8 PhD students
- 6 research fellows
- 12 affiliated or associated researchers

Planning and performing scientific research and technological development in the field of geophysics and geosciences in the marine and terrestrial environment

## METHODOLOGIES

- Seismic While Drilling (SWD)
- Vertical Seismic Profiling (VSP)
- Cross-well seismic
- Processing of seismic and geoelectric data
- DAS data processing
- Seismic modeling and modeling software development
- Hardware/software development for acquisition systems and data management
- Management, maintenance and activity planning of Piana del Toppo (PN) experimental test site

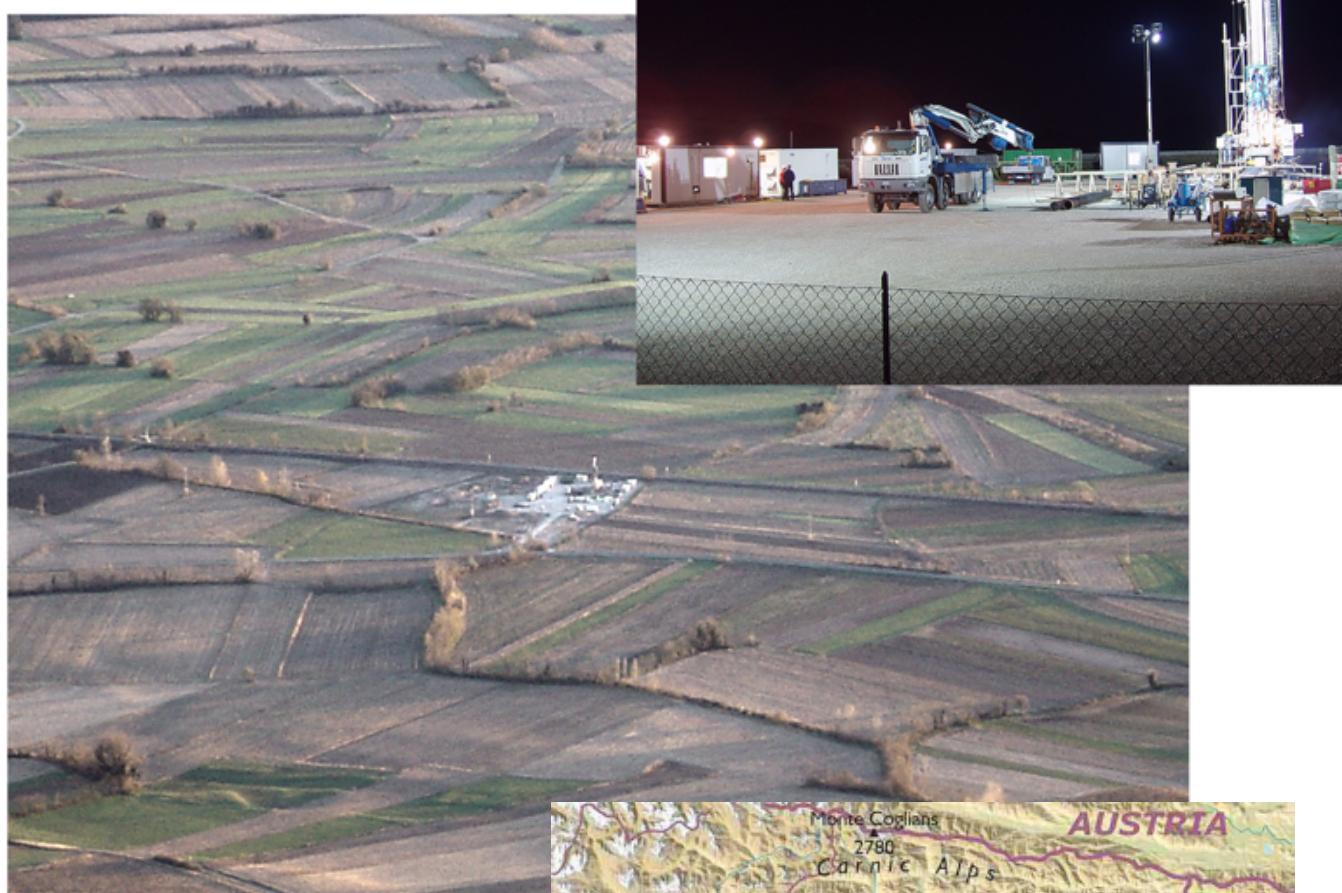


## APPLICATIONS

- Studies of well methodologies by VSP, RVSP and cross-well geometries
- Studies on geothermal energy, also in «Superhot» systems
- Studies on seismic methodologies by DAS (optical fibers)
- Researchs on CO<sub>2</sub> geological storage
- Geophysical studies on radioactive waste storage in the underground
- Seismic interferometry applications
- Experimental studies by seismic source emission (ground force)

## INSTRUMENTATION AND PITOP INFRASTRUCTURE

Piana del Toppo test site  
4 wells, 2 wells instrumented by geophones and optical fibers. Ground Force measure station equipped with load cells and accelerometer.



Laboratory of sensors measure and acquisition system design

Borehole sources (air-gun and sparker)

Geostuff borehole geophone 500 m cable with winch

Avalon ASR and Avalon Slim GSR borehole geophones 2000 m armored cable with winch

Vibrator source  
P waves ElViS VII



## ONGOING PROJECTS

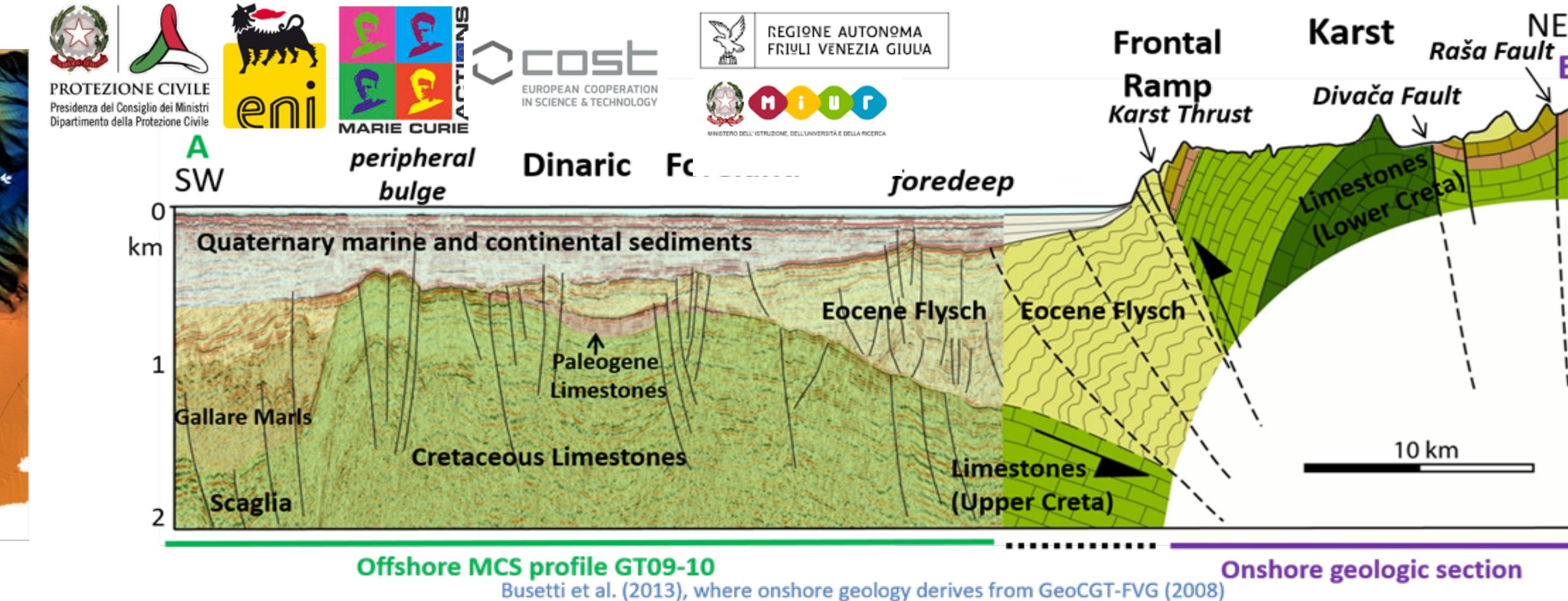
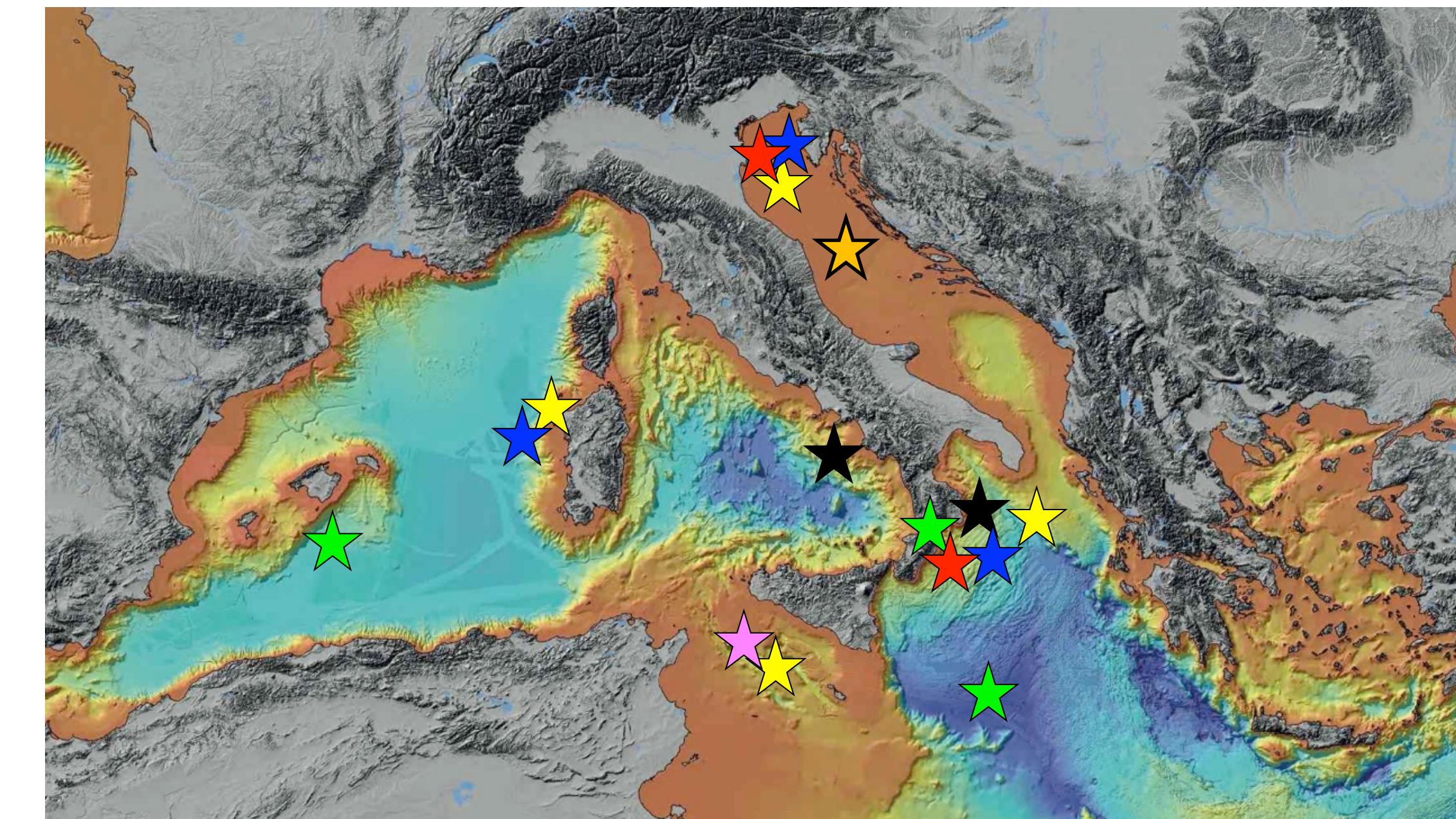


- H2020 ENOS (CCS) - CO<sub>2</sub> geological storage
- H2020 GEMex (Geothermal energy) - deep structures studies in geothermic superhot systems in Mexico
- SWD project with Aramco
- ACT SUCCEED project - joined use of geophysical methods for geothermal energy and CCS, also by using optical fibers
- COST project - Research network for including geothermal technologies into decarbonized heating and cooling grids

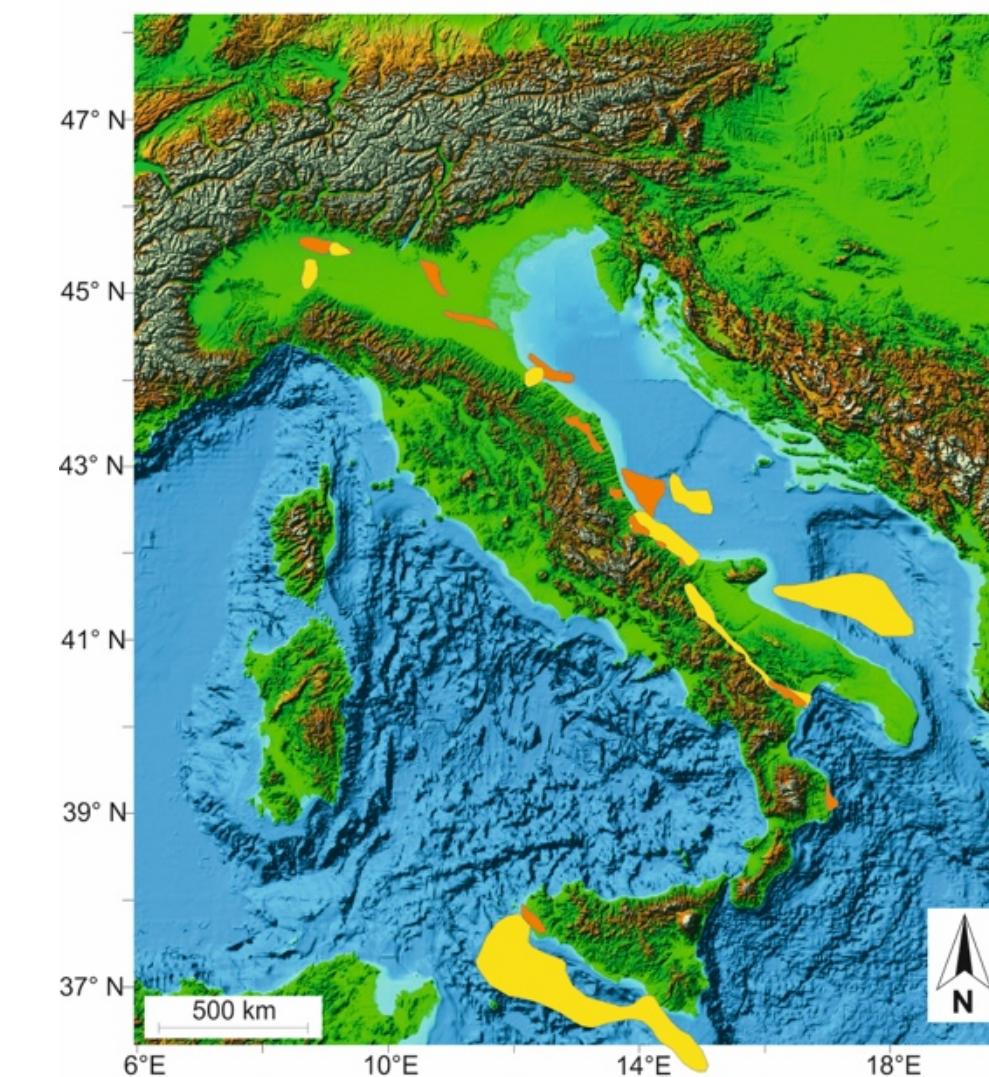
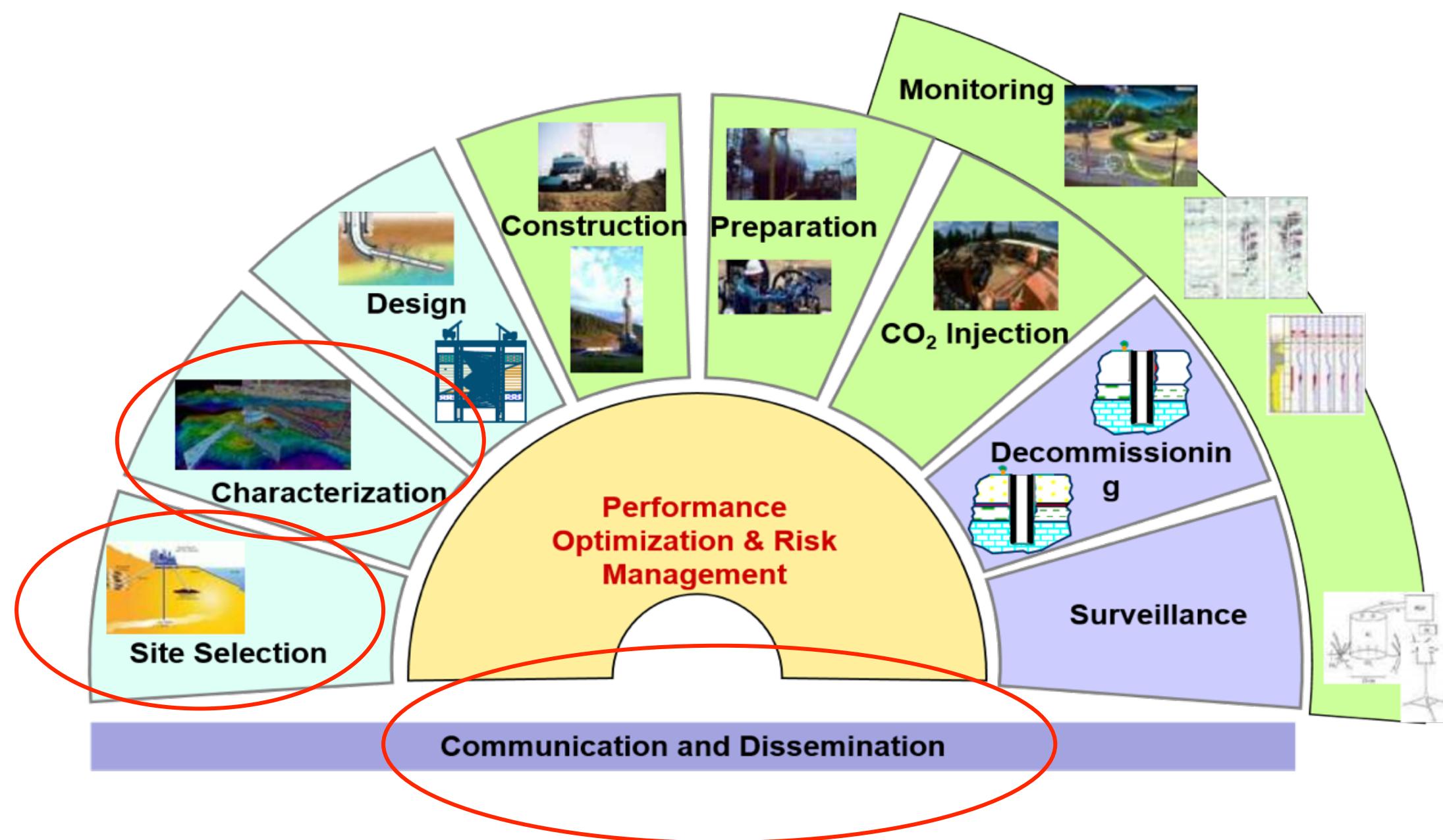
## GEODYNAMICS, BASIN ANALYSIS, GEOHAZARDS mainly in the marine environment

- ★ *BASIN ANALYSIS*
- ★ *ACTIVE TECTONICS*
- ★ *SUBMARINE MASS FAILURES*
- ★ *GEOHAZARDS ASSESSMENTS*
- ★ *SALT DYNAMICS & GAS SEEPAGE*
- ★ *SUBMARINE VOLCANOES*
- ★ *FLUID FLOW EMISSIONS*

Marine seismic reflection, bathymetry, sediment sampling, gravimetry, magnetics



## GEOLOGICAL STORAGE OF CO<sub>2</sub>



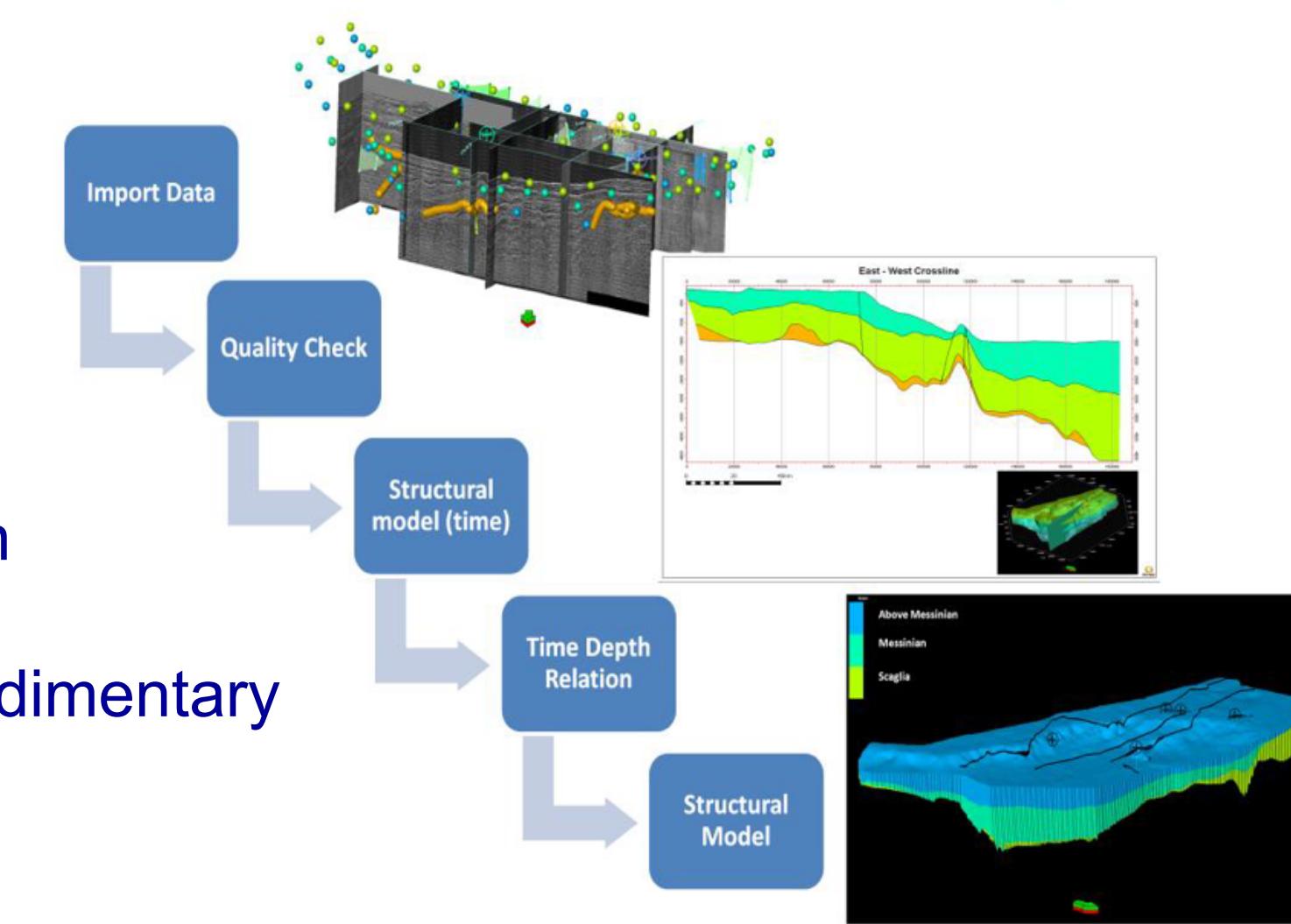
The first map of the potential CO<sub>2</sub> storage sites in Italy (from Donda et al., 2011, Civile et al., 2013)



European Strategy Forum  
on Research Infrastructures



Marine seismics  
Borehole-seismic correlation  
Well log analysis  
Petrophysical analysis of sedimentary sequences

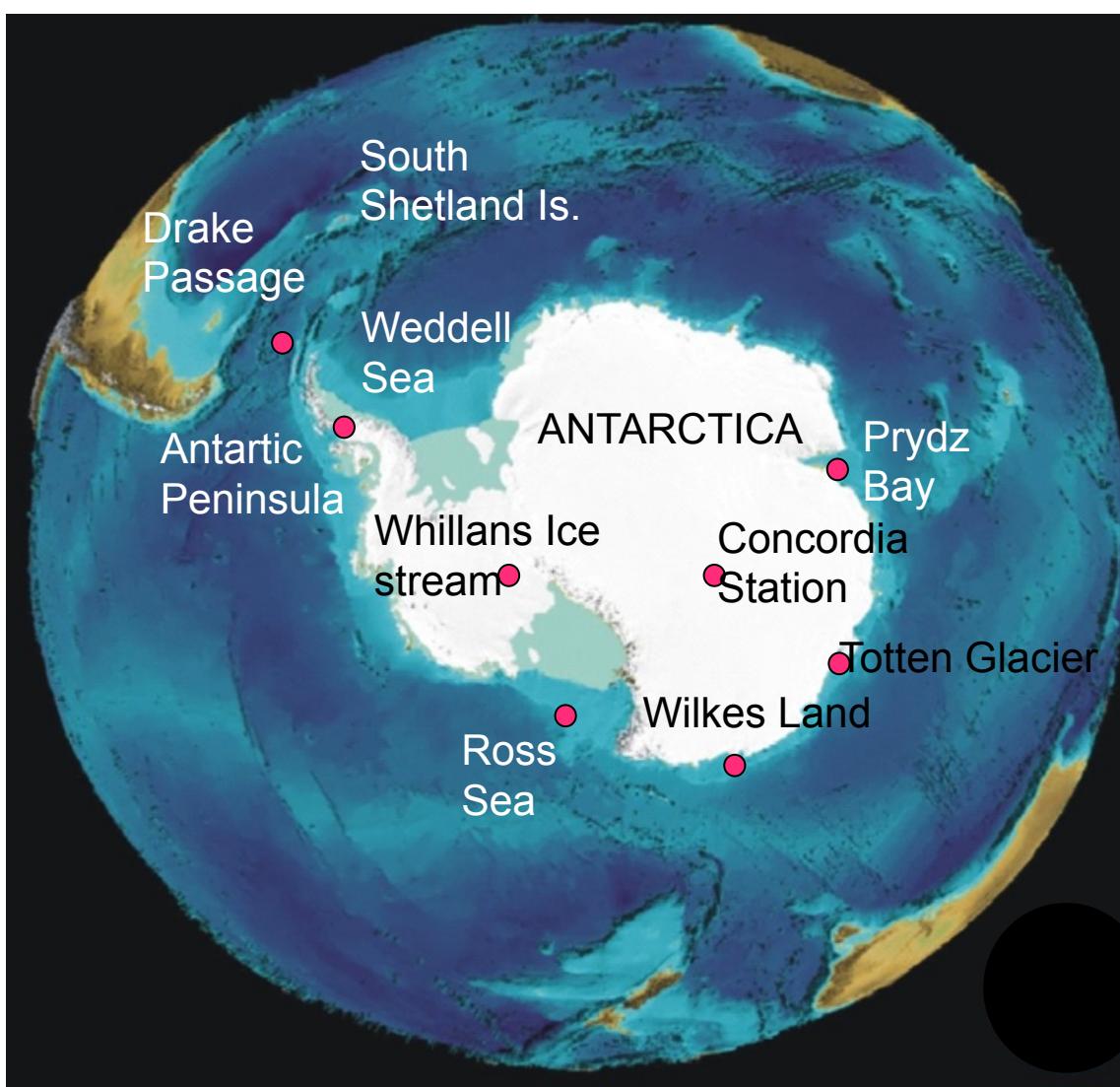


## PALEOCLIMATIC RECONSTRUCTIONS

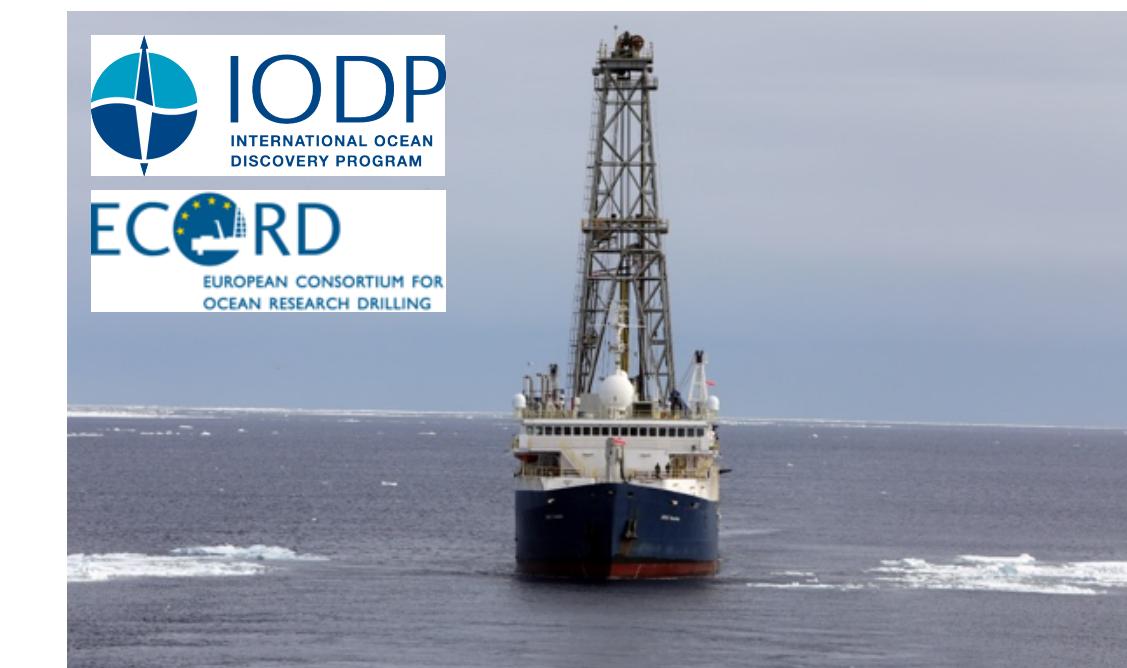
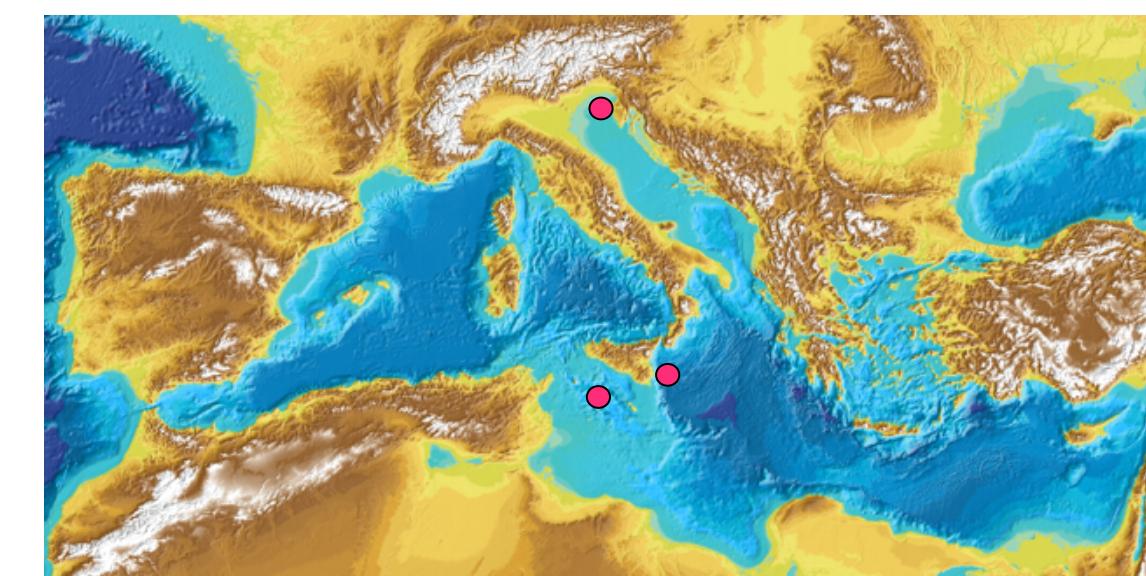
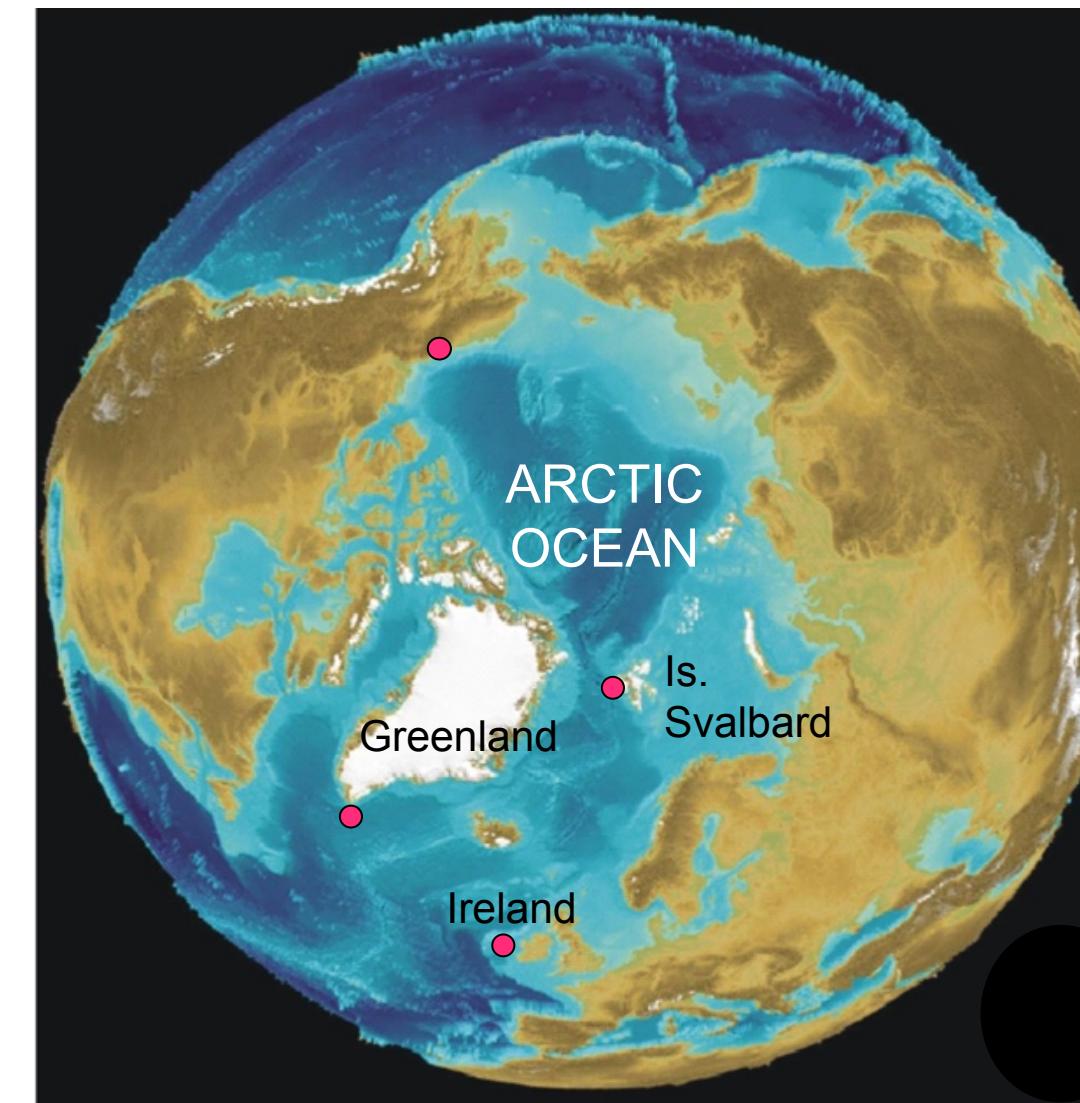
Ice-ocean-sea bed interactions; Sea-level change, Climatic transitions

Paleo-ice sheet modelling

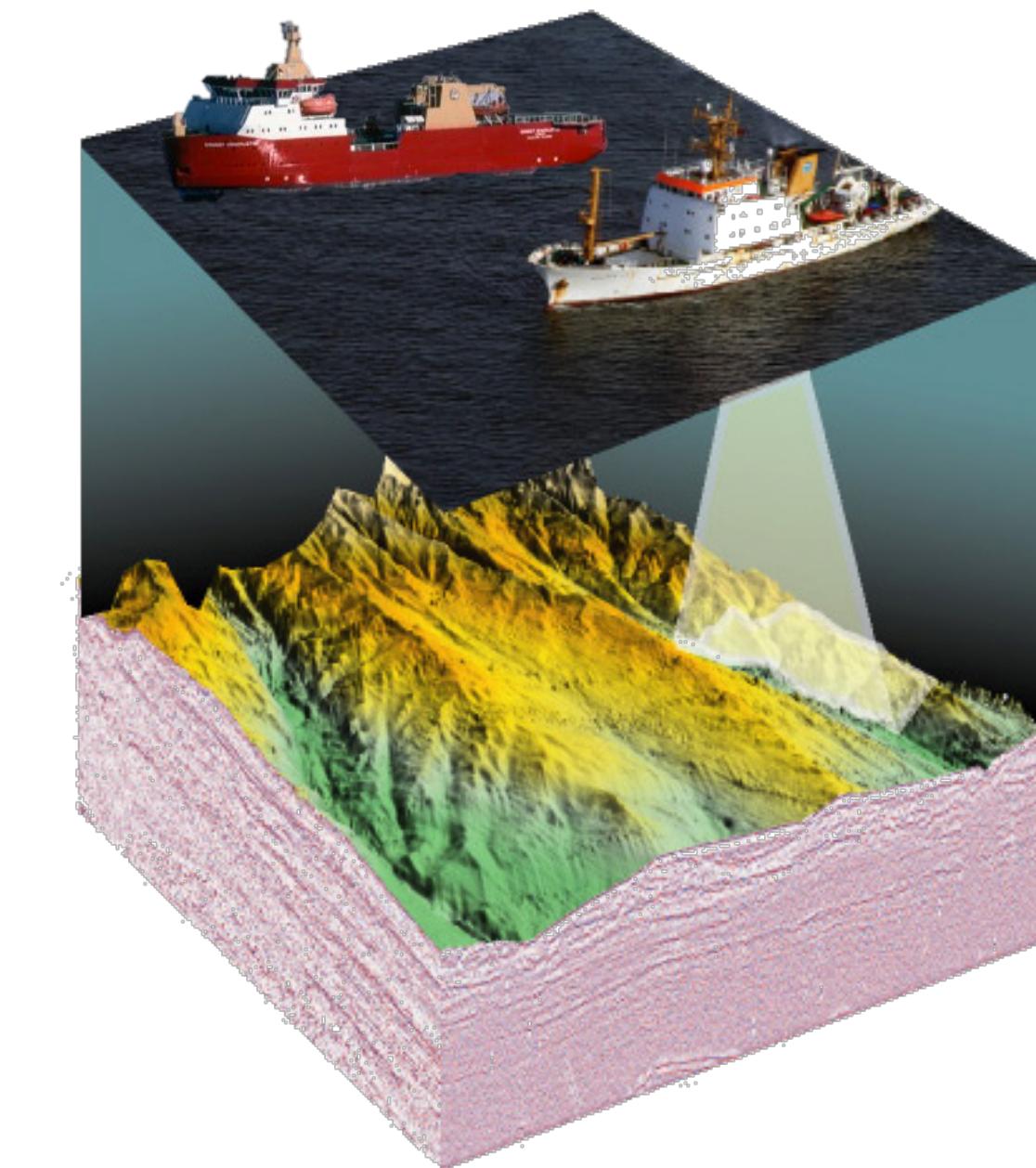
Marine geophysics, Marine Sedimentology, Scientific drilling,  
Numerical modeling



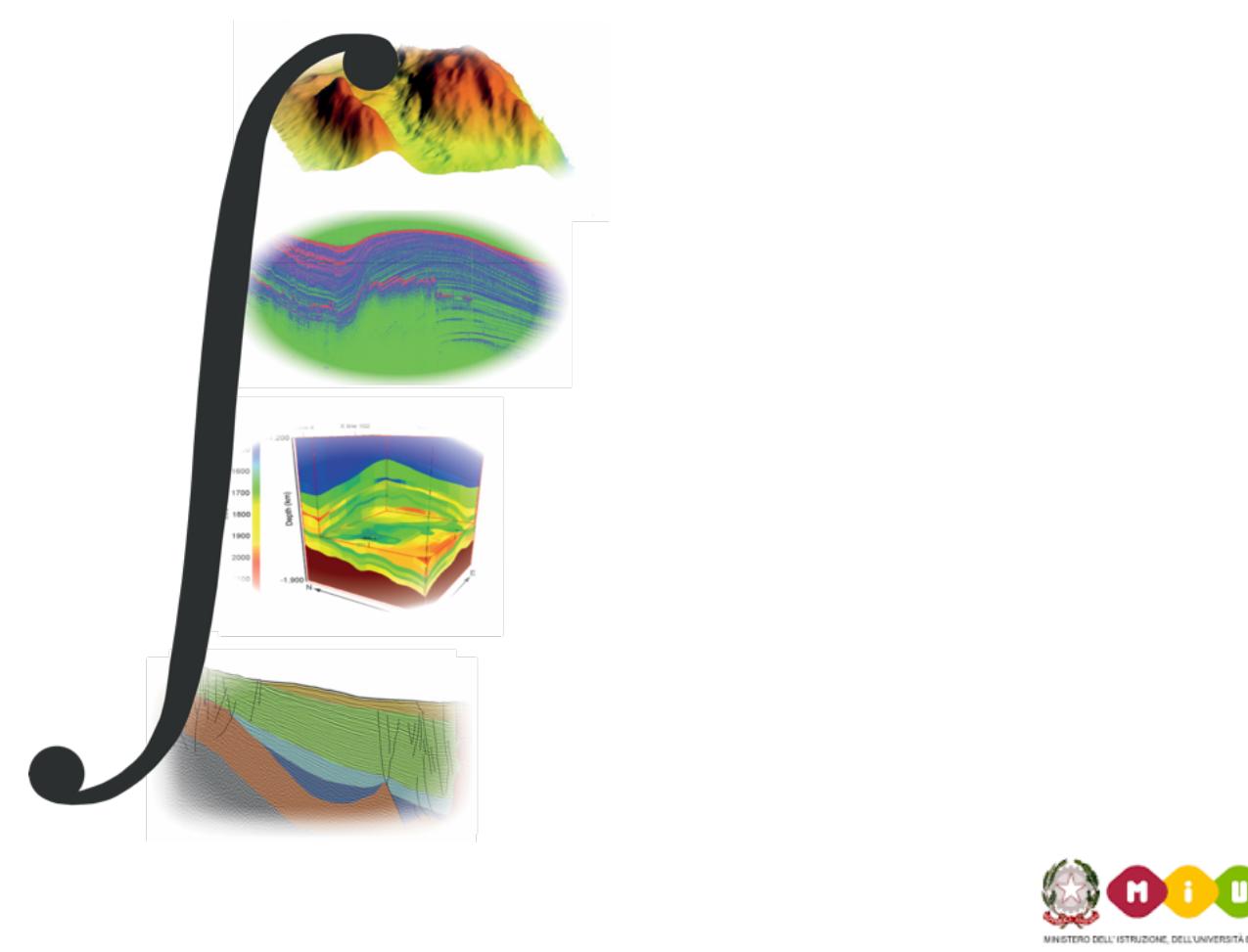
11 Antarctic cruises (1988-2017)  
4 Arctic cruises (2008-2016)



Co-chief scientists of  
ODP178 & IODP374  
Shipboard scientist ODP Leg 188



## LABS for geophysical interpretation and non-destructive sediment analyses



**joint laboratory between OGS and the University of Trieste (Italy), for non-destructive analysis.**

- high resolution physical properties logging
- high resolution photography
- multi-angle 2D radiographs



## PARTICIPATION IN SCIENTIFIC PANELS



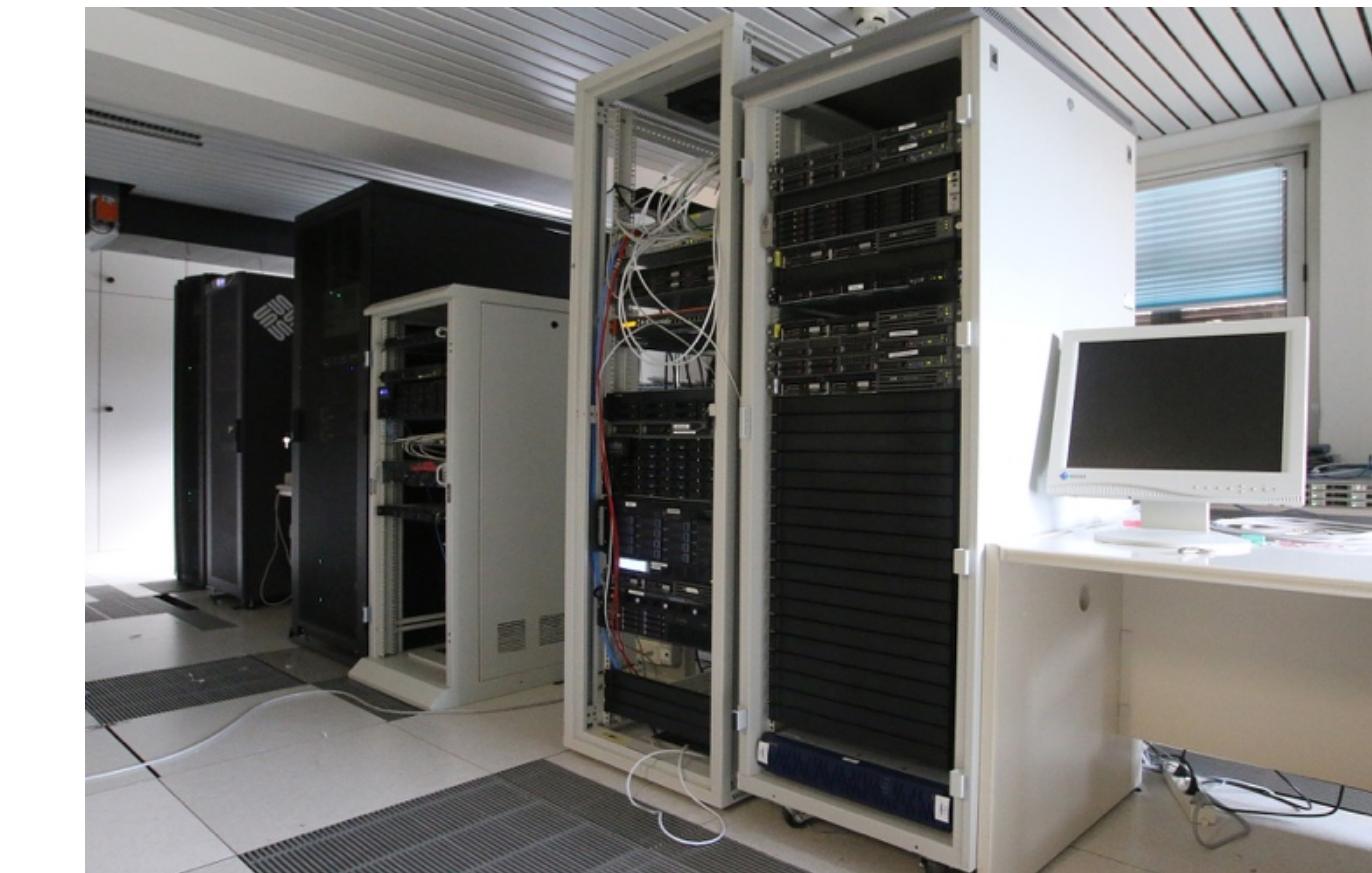
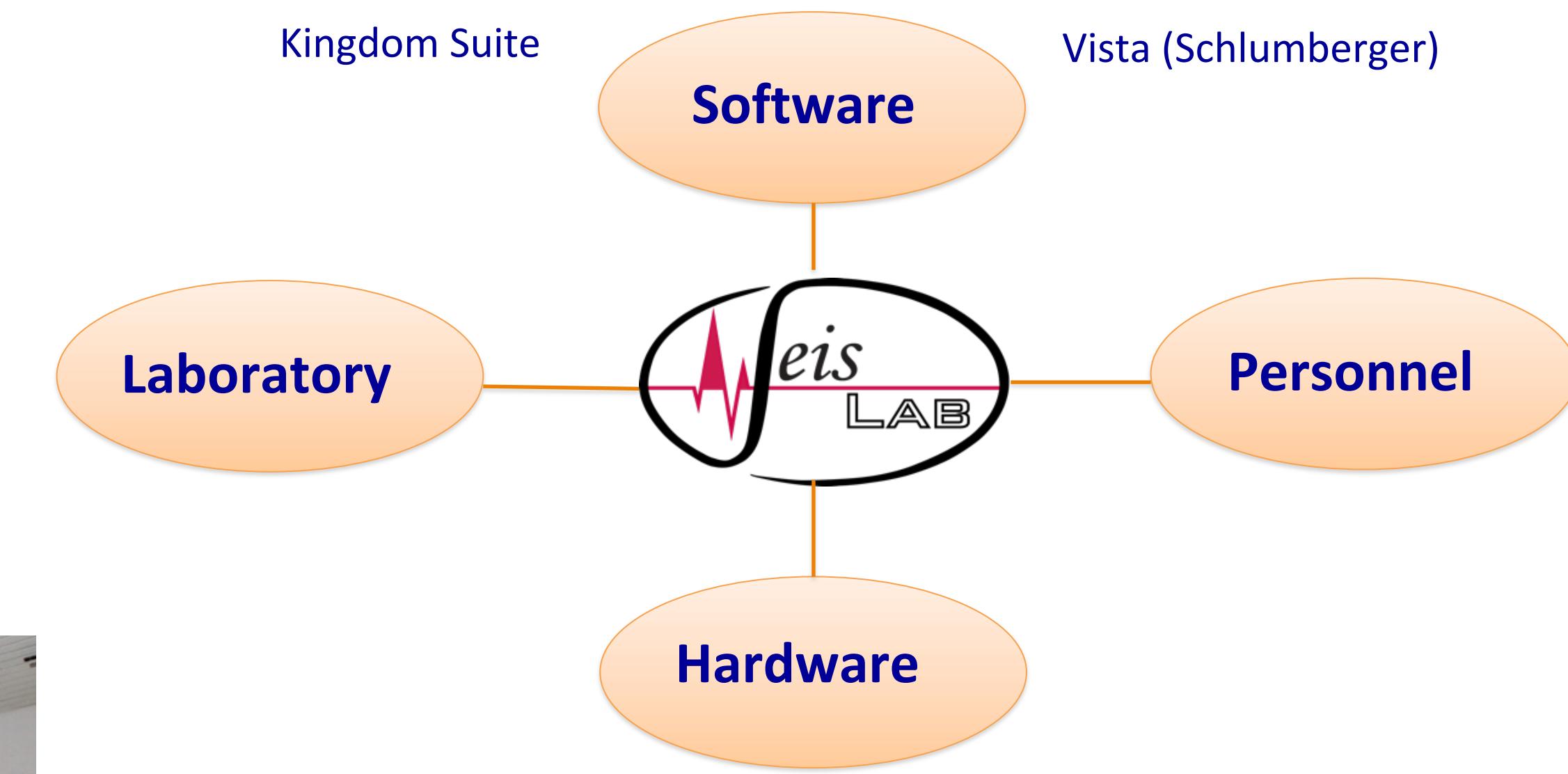
## TRAINING & EDUCATION

### OUTREACH



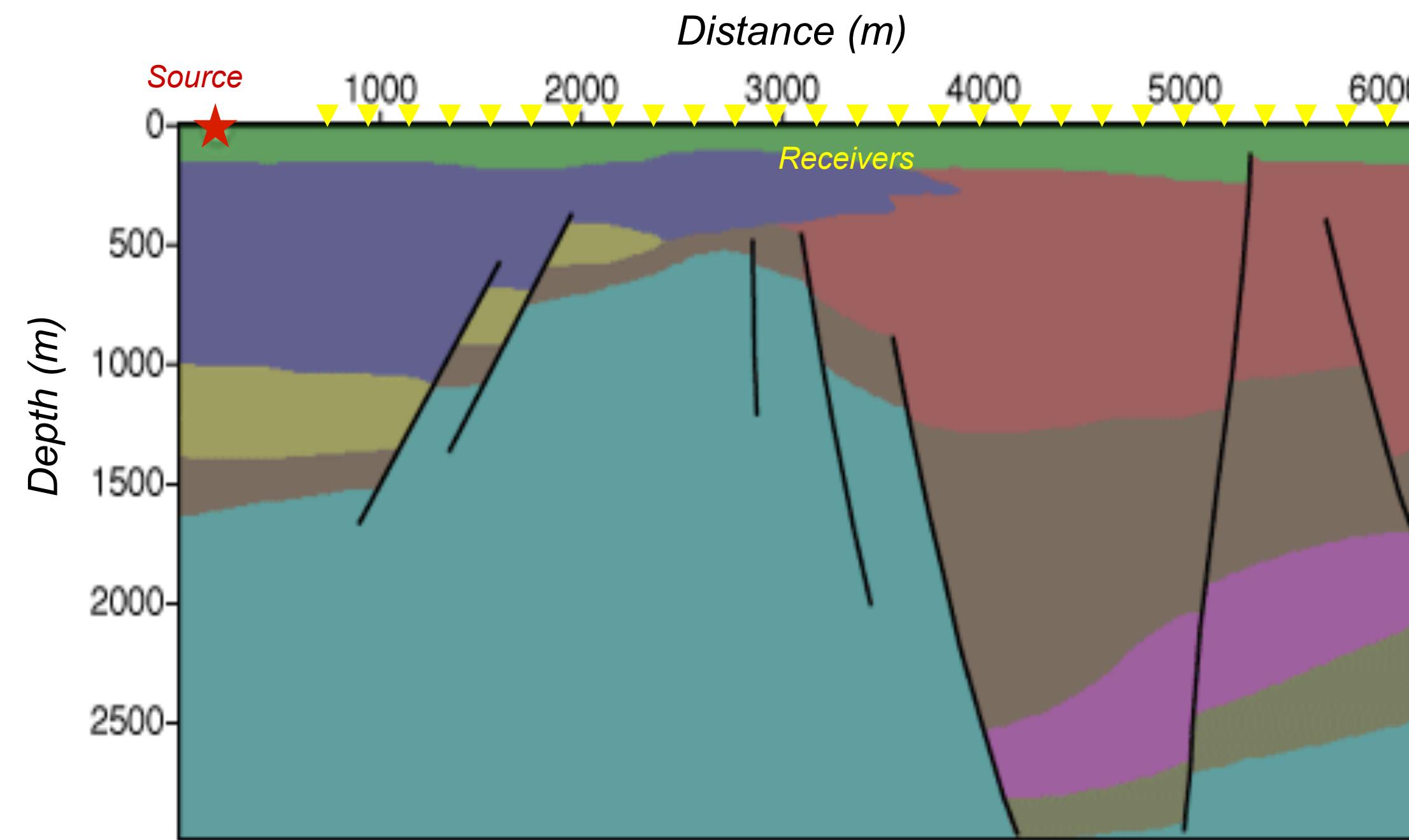
## Research Infrastructures - Seislab

Seislab is an hardware/software infrastructure constituting an environment for the integration of geophysical software and data. Based on the concept of hardware virtualization, Seislab helps the user in performing part or all the steps of processing and analyses considered in the workflow.

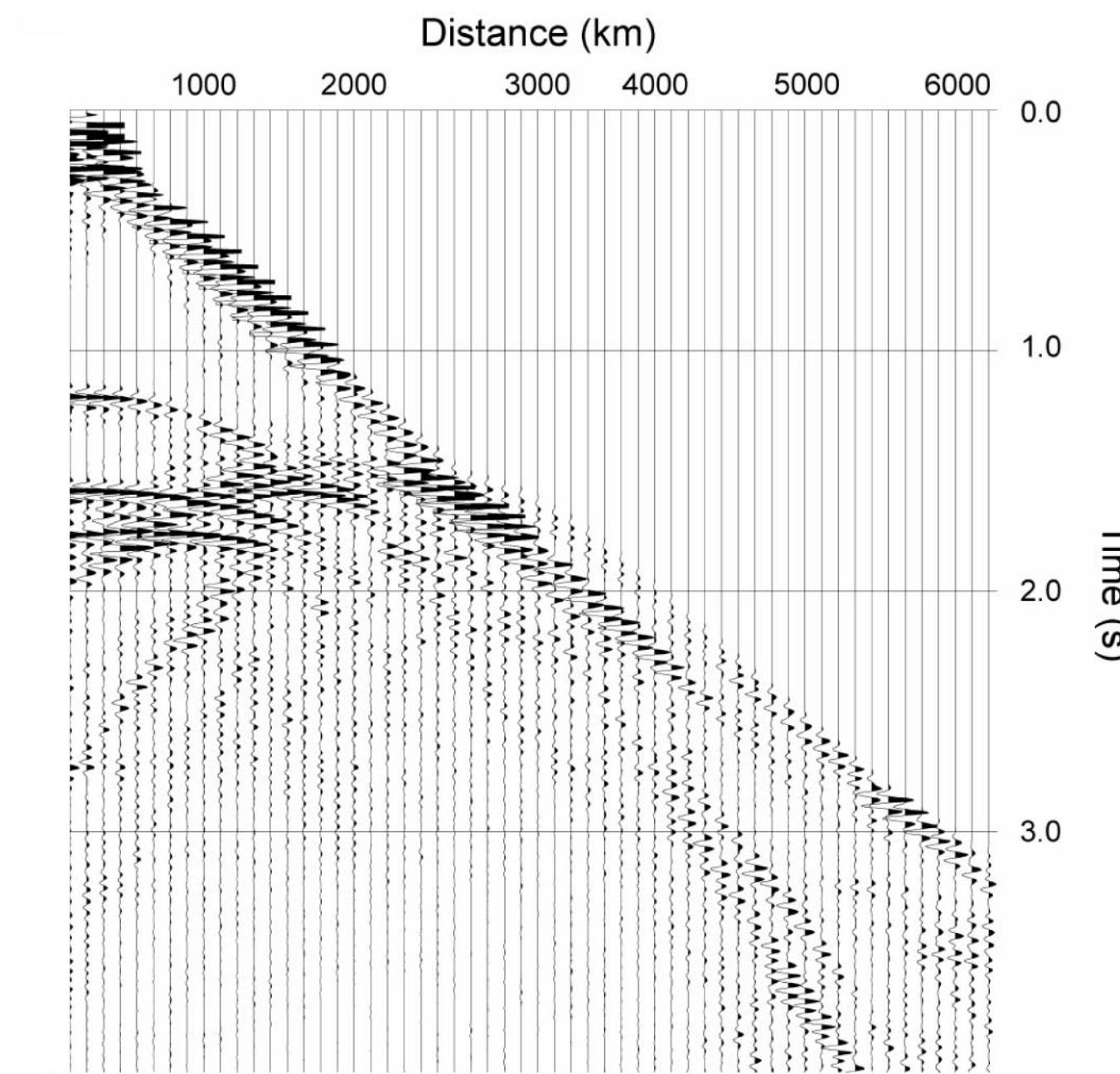


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 Davide Gei  
 Aronne Craglietto  
 Philippe Cance  
 Gianni Madrussani  
 Riccardo Geletti  
 Valentina Volpi  
 Dario Civile  
 Alberto Brosich  
 System administrator

## Research tools - Seismic numerical modeling



*Geological – petrophysical model*



*Shot gather  
Synthetic seismogram*

Seismic numerical modeling is a technique for simulating wave propagation in the earth. The objective is to predict the seismogram that a set of sensors would record, given an assumed structure of the subsurface. This technique is a valuable tool for seismic interpretation and an essential part of seismic inversion algorithms.

# Research Tools - CAT3D – Computer Aided Tomography for 3D models

## An OGS project for the development of a tomographic software pakage

Projec manager: G. Böhm

In collaboration with: A. Vesnaver, G. Rossi, G. Madrussani, S. Picotti, F. Accaino, U. Tinivella



First version was born in 1993, actual version (6.1) contains about 95000 lines of code and about 90000 lines of graphic interface.

### Included in Cat3d

*SEISMIC TOMOGRAPHY  
P - S velocity*

*EARTHQUAKE TOMOGRAPHY  
P - S velocity*

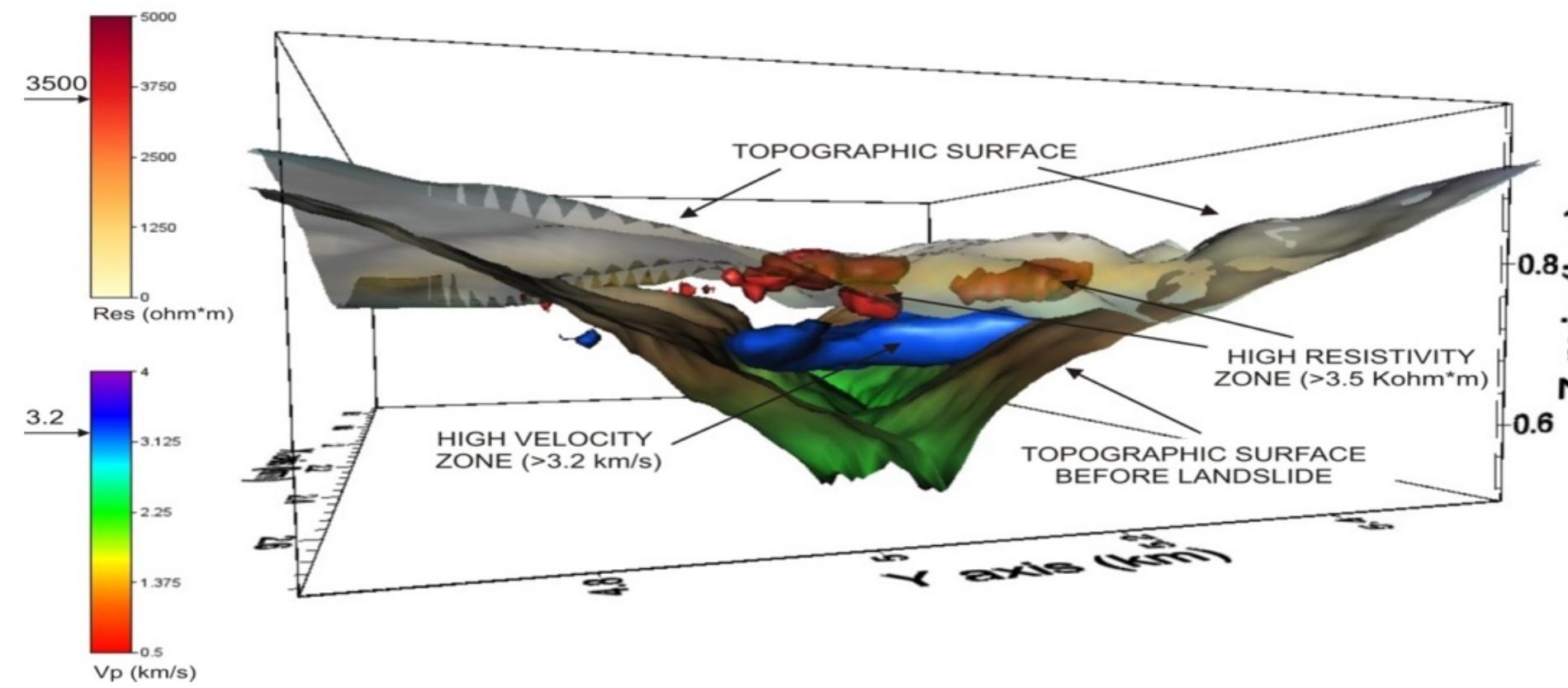
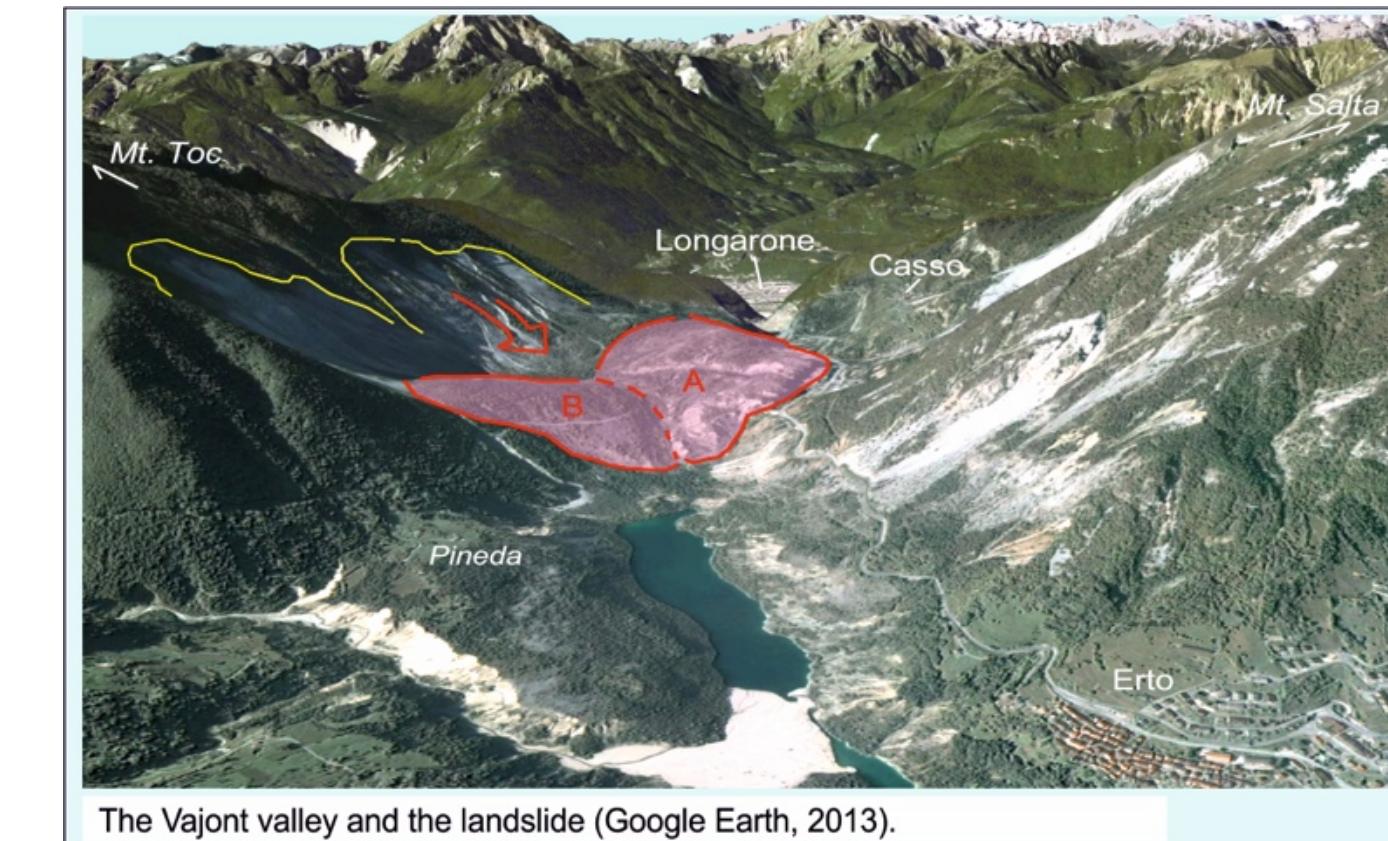
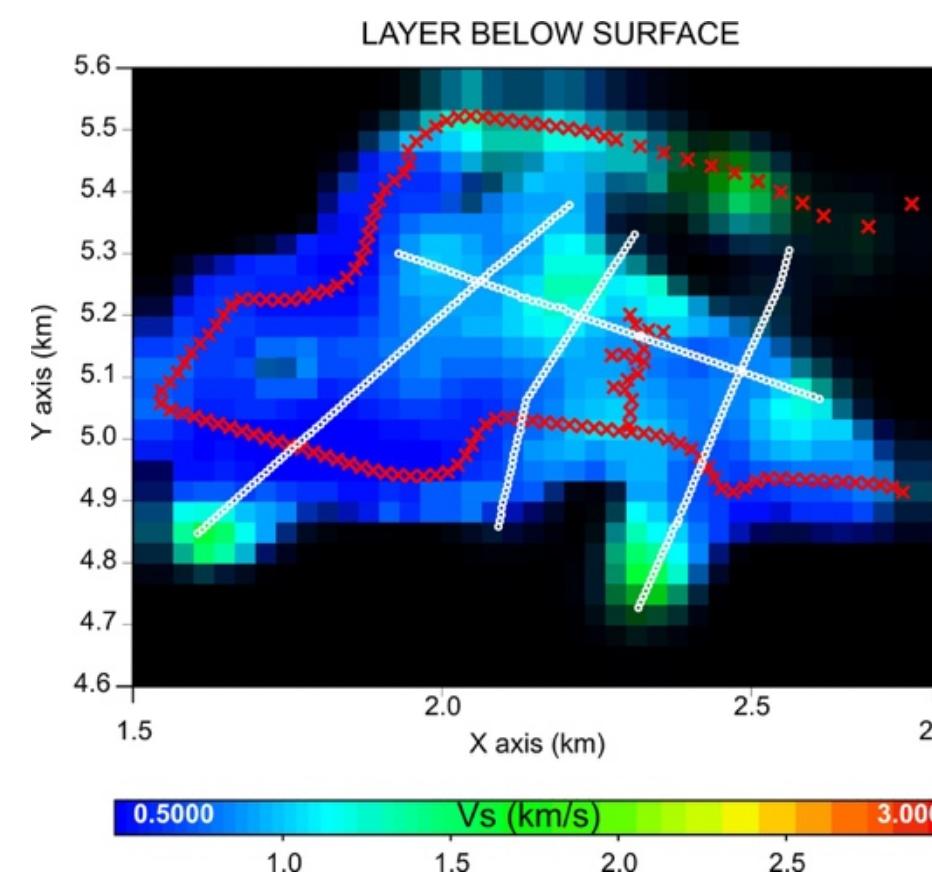
*ATTENUATION TOMOGRAPHY  
Qp - Qs*

*HYDRAULIC TOMOGRAPHY  
hydraulic diffusivity*

*ELECTROMAGNETIC TOMOGRAPHY  
magnetic diffusivity / electrical conductivity*

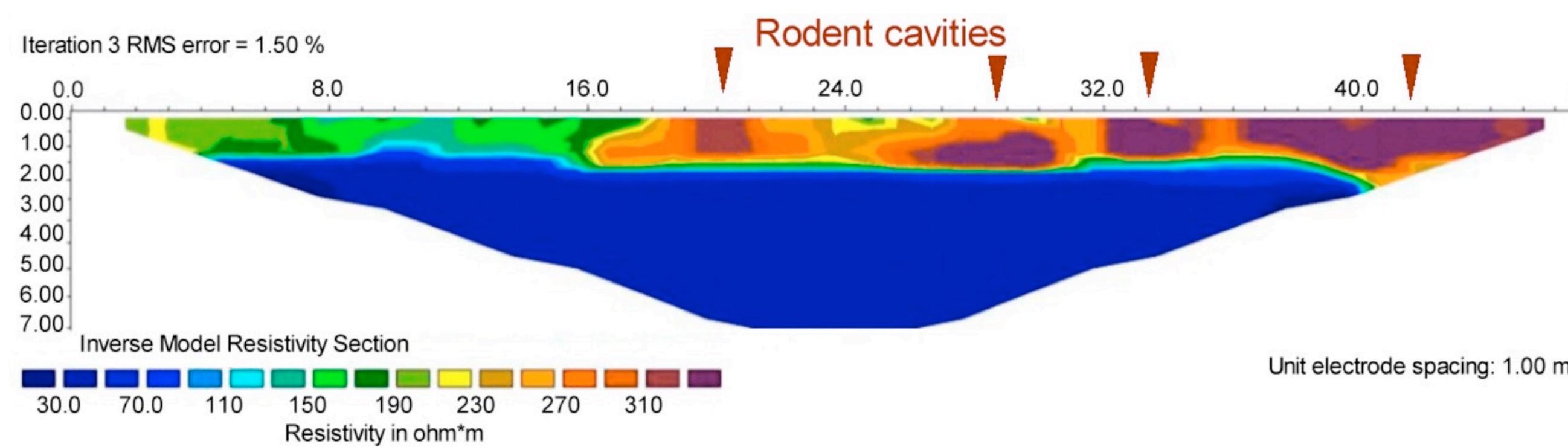
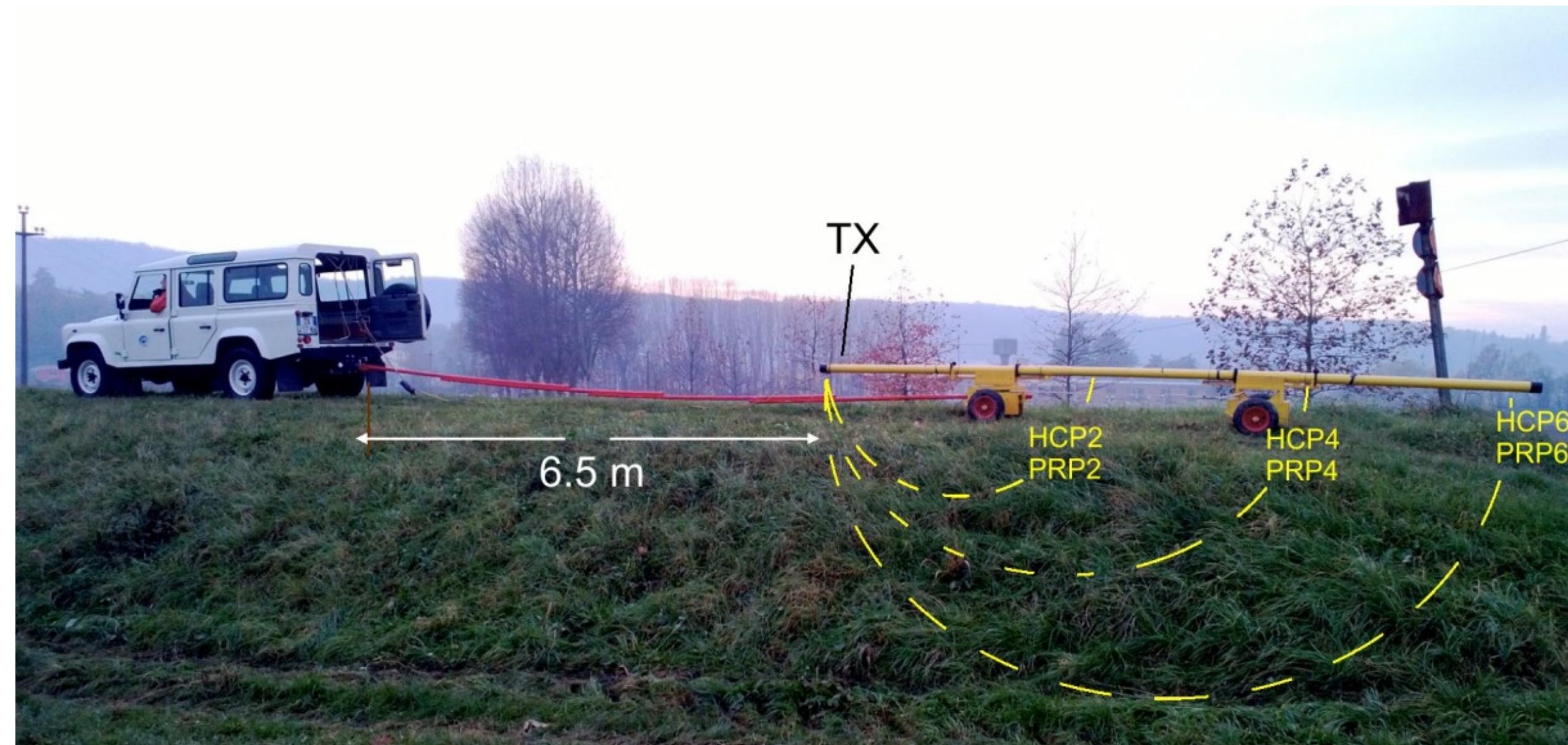
# Geophysical investigation on landslides

## Electrical resistivity and Seismic data Integration



An important refinement of the collapse model and a validation of the associated theories could be obtained by a better characterization of the geometry and the physical properties of the different geological units embedded in the landslide body.

## Integrity of River levees



**Multi-Source system for geo-electrical surveys ERT (Electrical Resistivity Tomographic)**

The approach is to measure the electromagnetic (EM) response, specifically, the electrical conductivity profile of the levees.

The combination of EM induction, GPR and Geoelectric methods guarantees high resolution, low cost and high speed of the measurements that are carried out dynamically by moving the sensors along the bank axis.

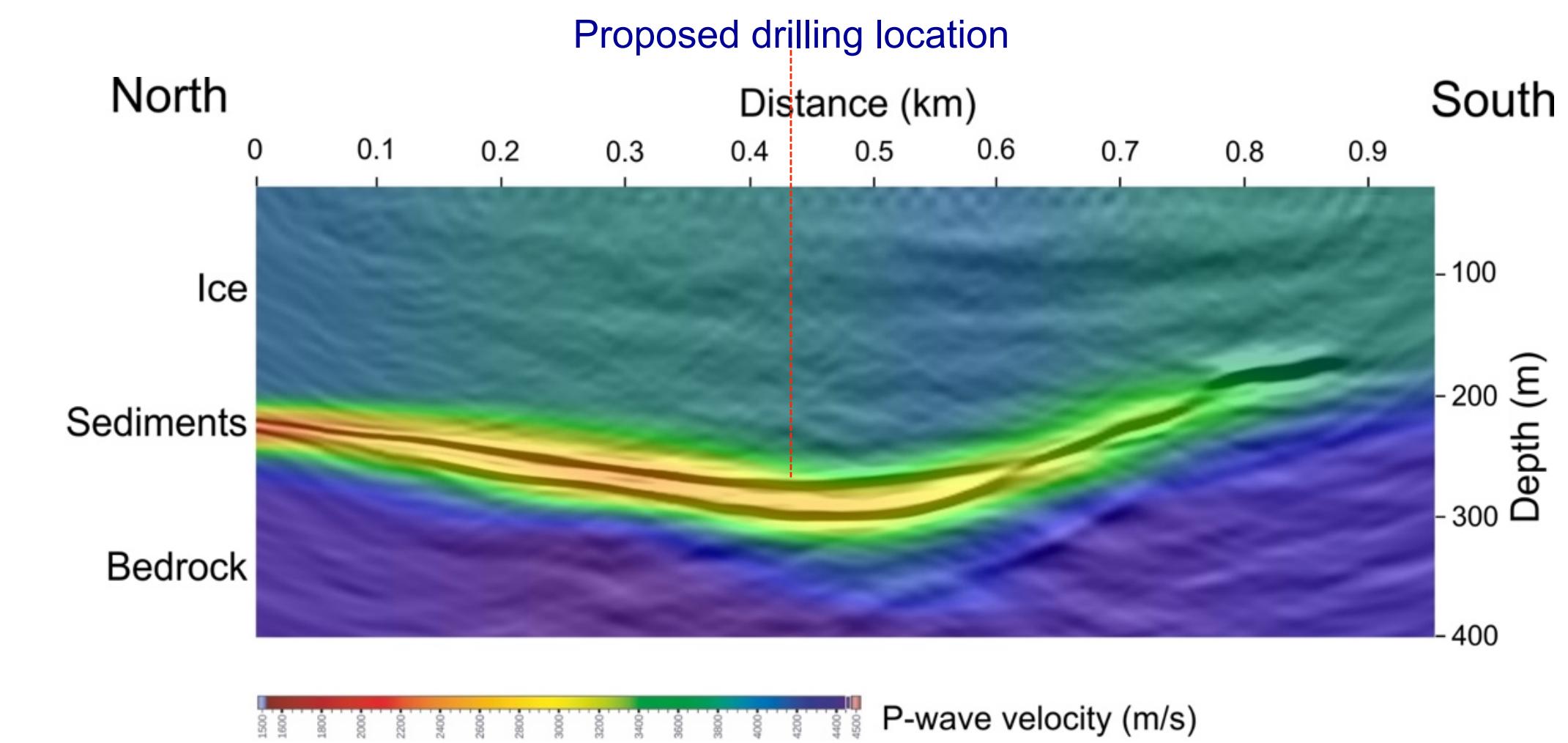


## Geophysics on ice

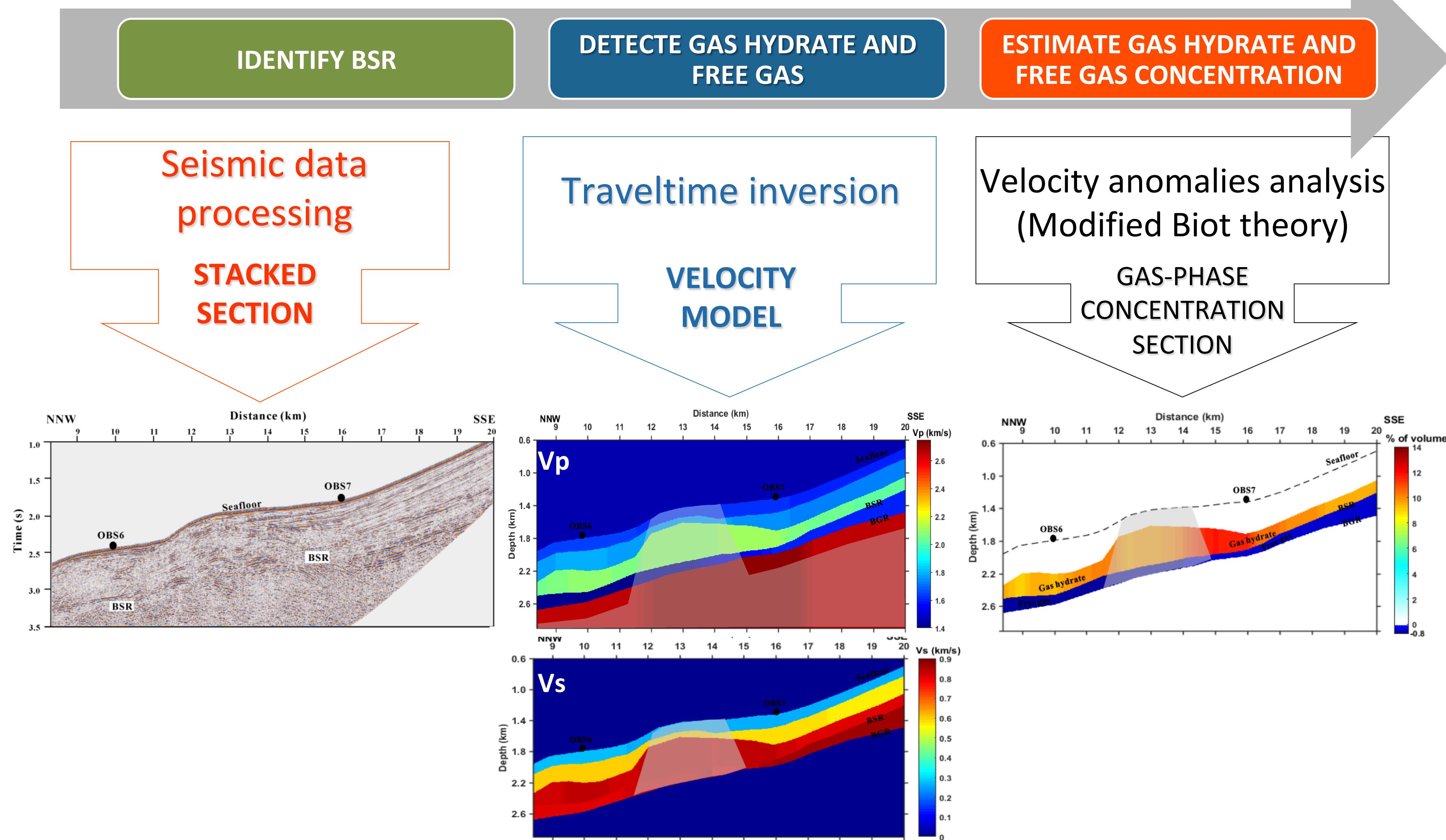
The motivations of these studies are the following:

1. Geophysical experiments have direct implications for the predictive modeling of ice streams stability.
2. Subglacial environments probably contain the history of Antarctica prior to 800,000 years ago. In particular, subglacial lakes could be the habitat of unknown organisms isolated from the rest of the world for a long time.
3. Glaciers represent one of the most important archive of climate and environmental information.

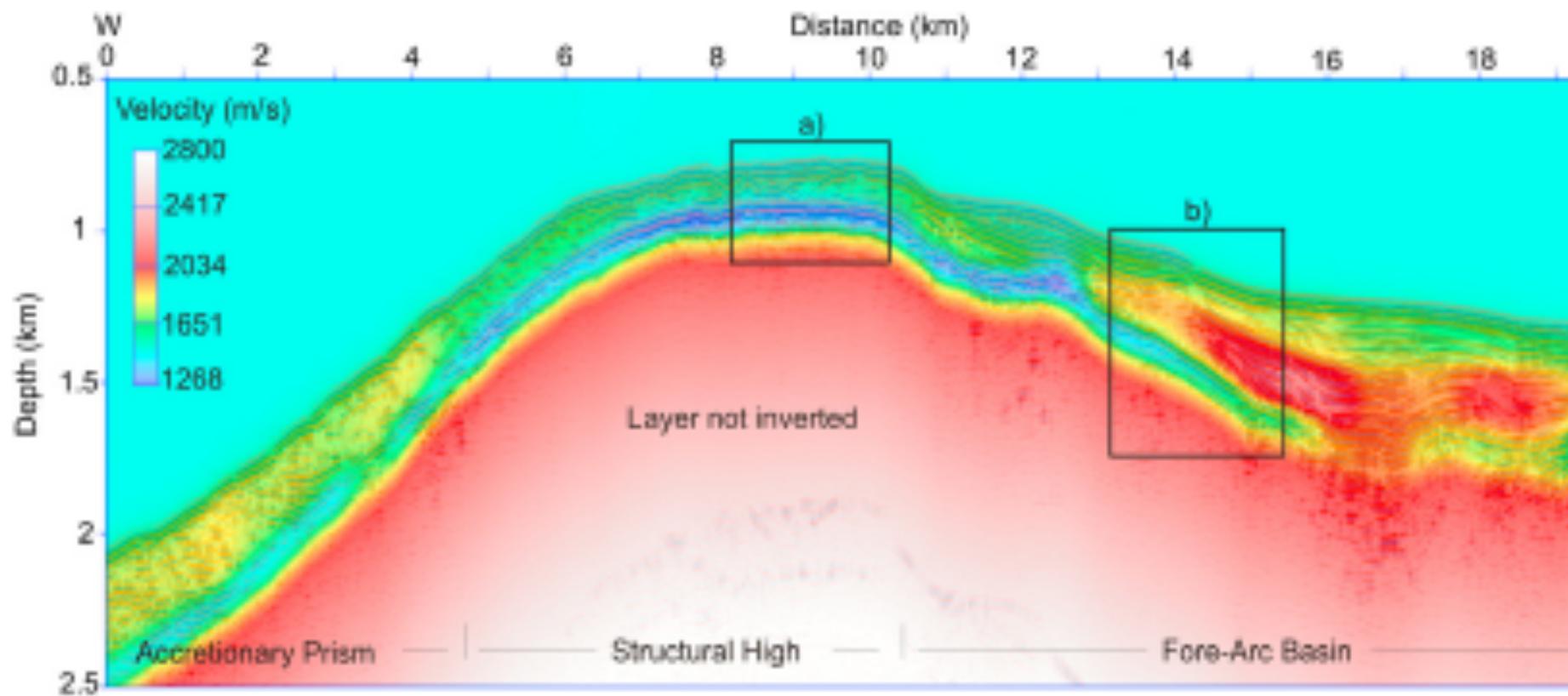
Active seismic Imaging of the Pian di Neve glacier (Adamello Massif) with a proposed drilling location.



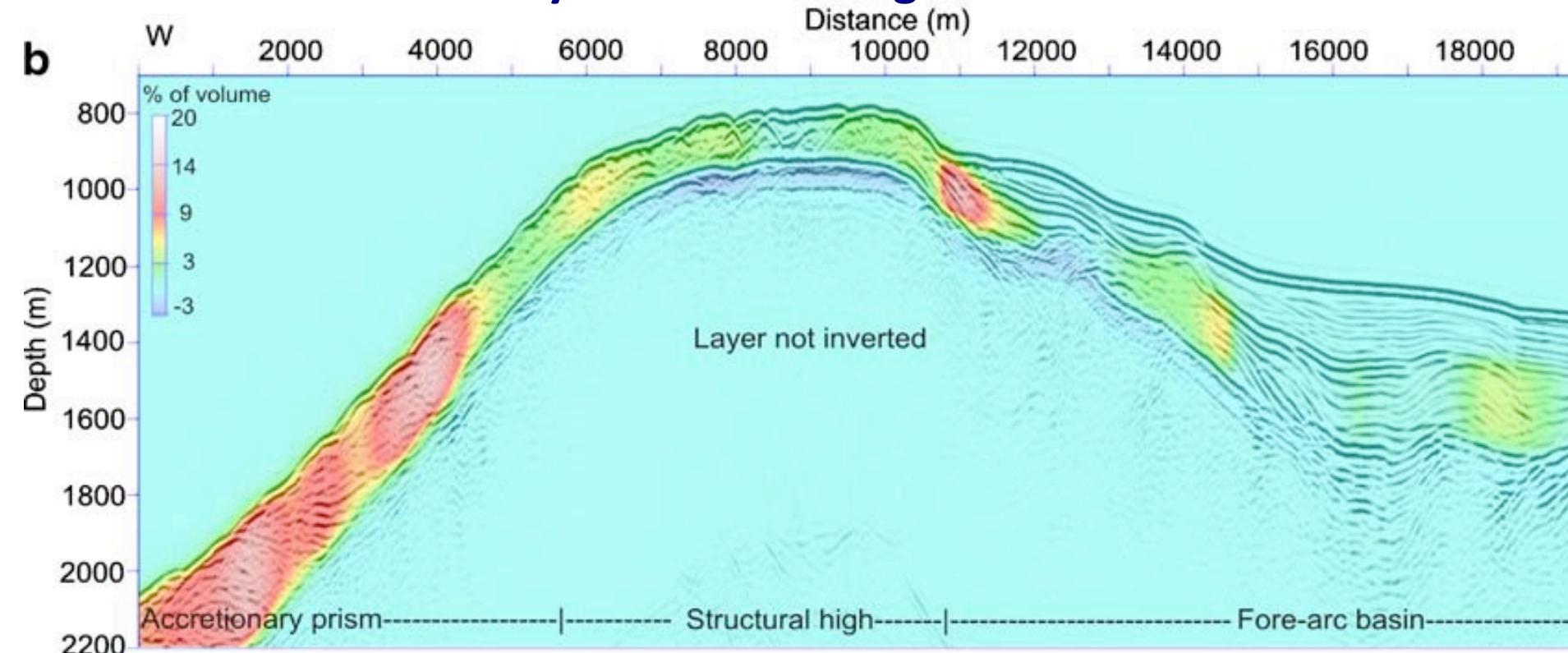
# Gas Hydrate: environmental and climate impacts



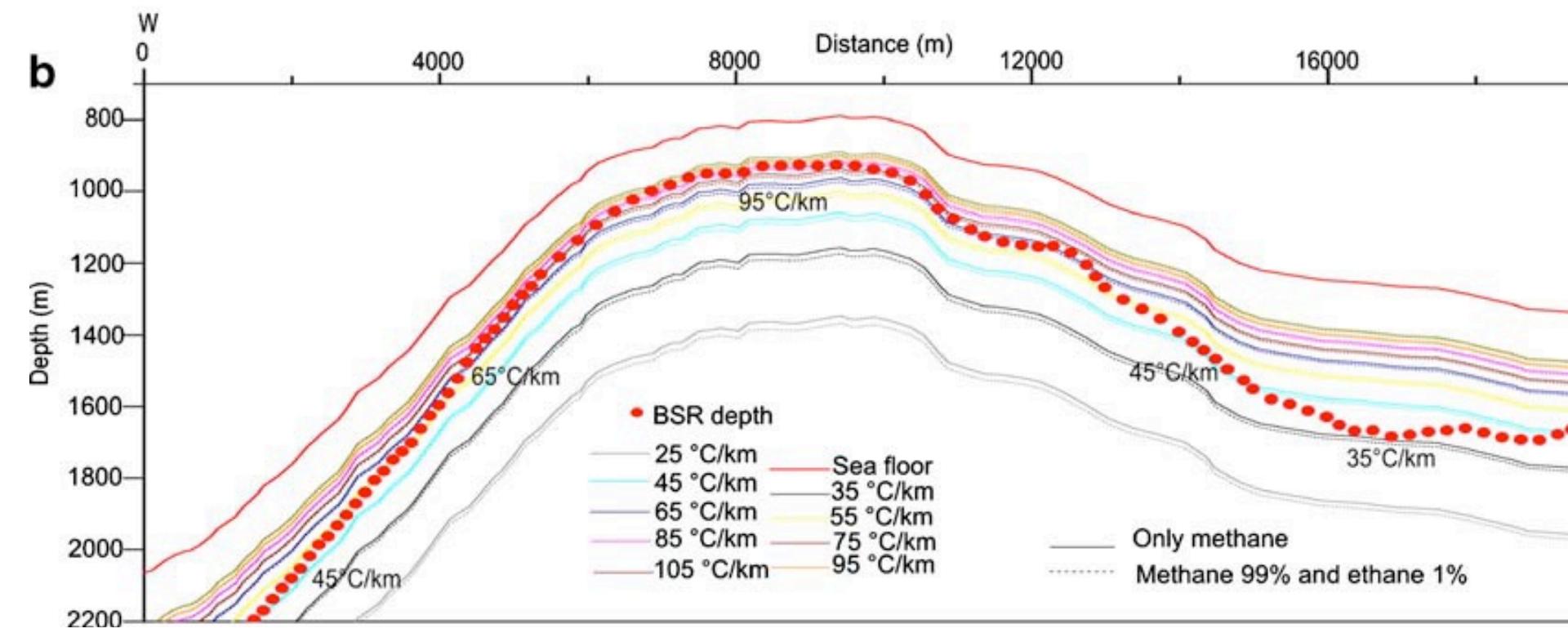
## Velocity model and pre-stack depth migration



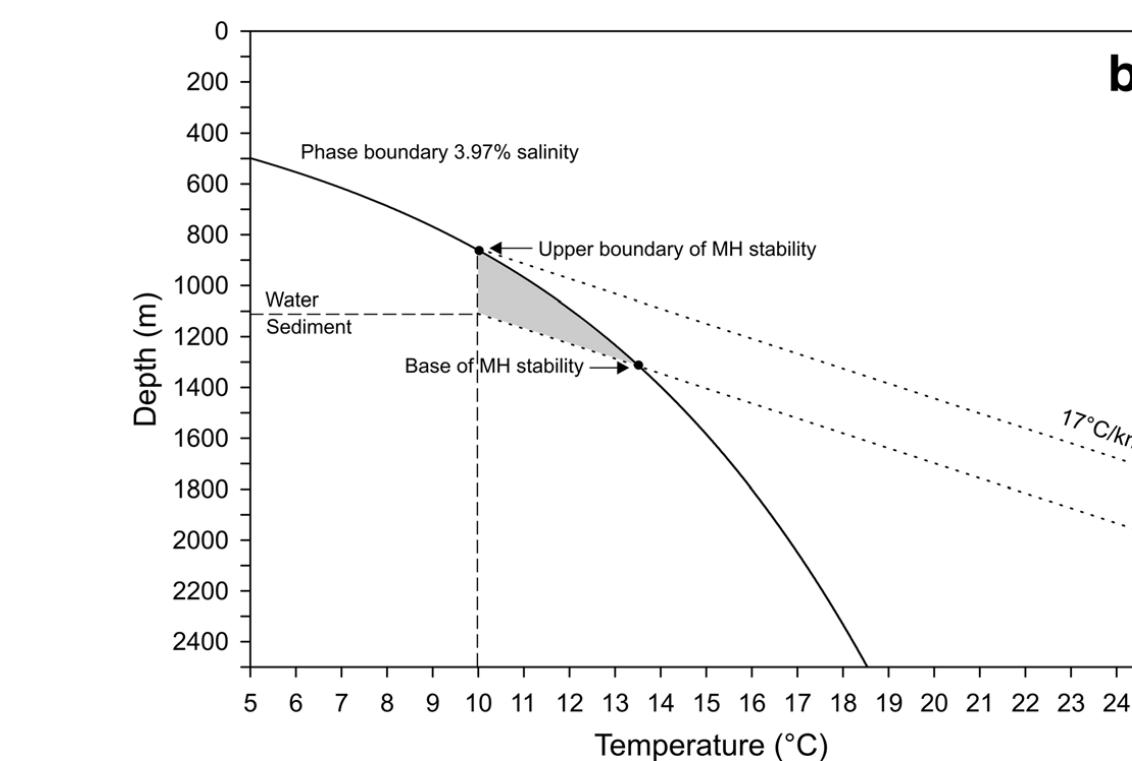
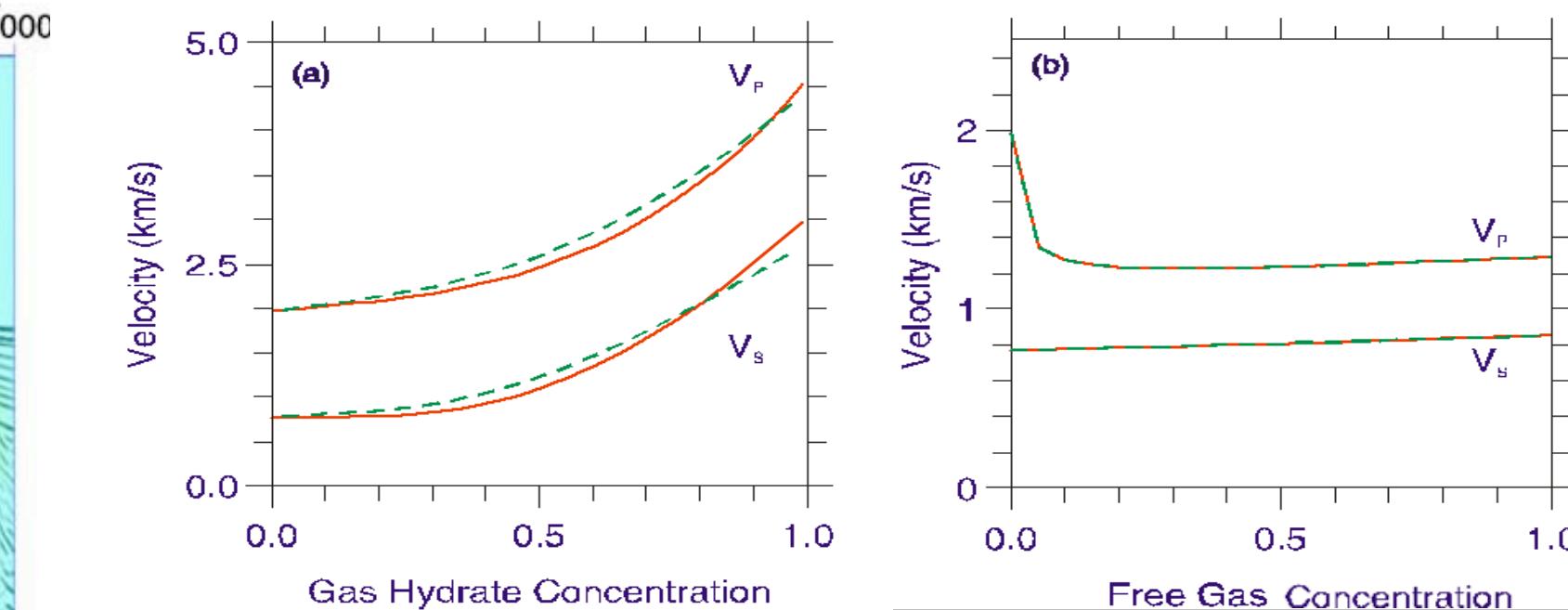
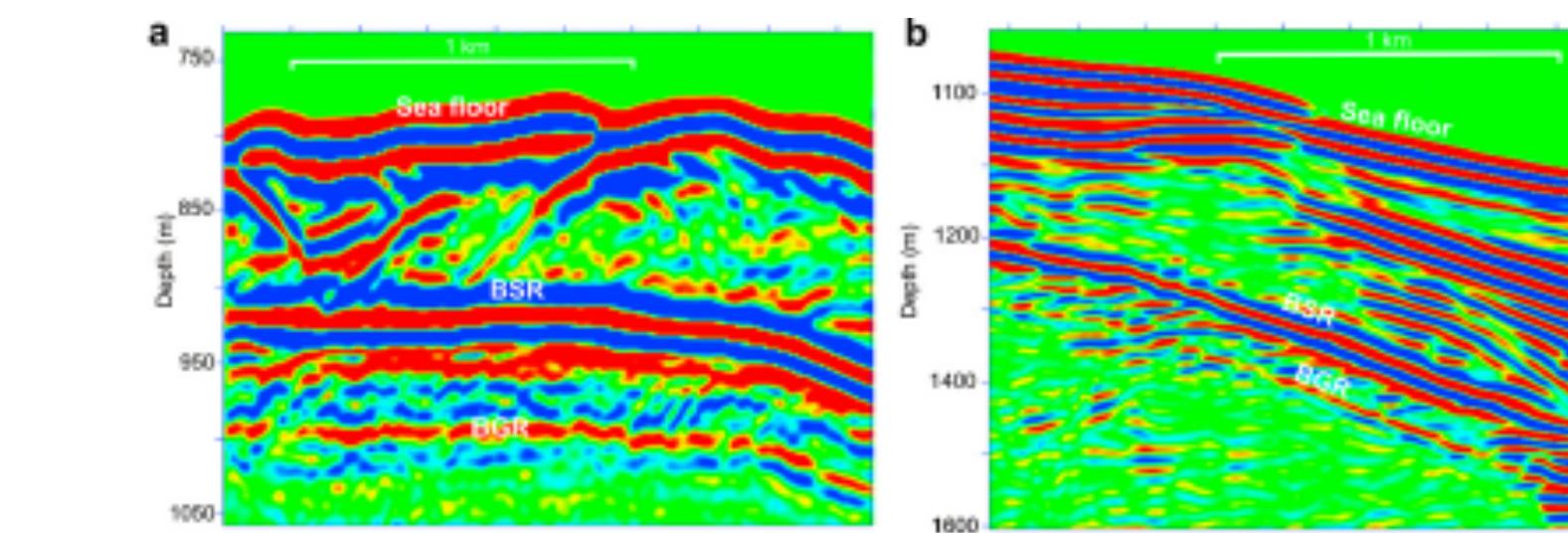
## Gas hydrate and free gas concentrations



## Geothermal gradient obtained from hydrate stability modeling



## Seismic analysis and modeling: example of Chilean margin



## Other Research Activity

Recovery of vintage gravimetric data and processing with current methods to make them usable by the community (Seislab)

Implementation of procedures for modifying and processing the seismic data format in order to obtain an easier utilization by the user (Seislab)

Geophysical research for groundwater resources



## Publications 2019

69 publications (58 indexed in SCOPUS and 11 conference papers)

**IF>3**

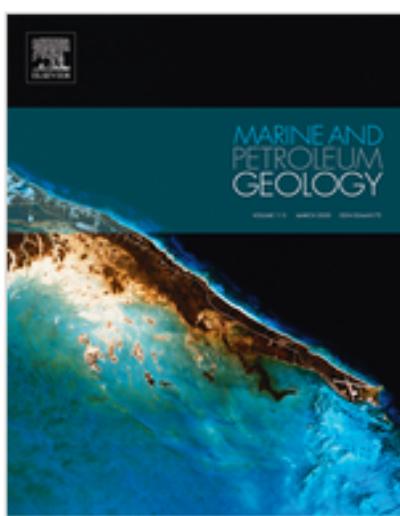
	<b>IF</b>
1 Nature Geoscience	14.291
2 Earth-Science Reviews	9.530
1 Surveys in Geophysics	5.226
2 Basin Research	3.886
1 Marine Geology	3.349
1 Journal of Geophysical Research	3.440
2 Marine and Petroleum Geology	3.281
1 Geomorphology	3.308
1 Journal of Glaciology	3.261

Increasing trend in number of publications

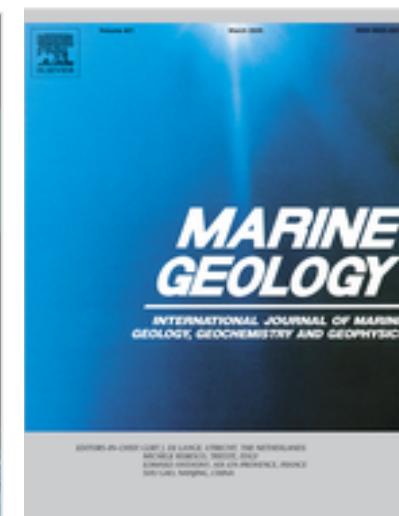
Increasing trend in IF of journals

## Editorial activity

### CHIEF EDITORS OF



Massimo  
Zecchin



Michele  
Rebesco

Camerlenghi (Ed. Board Marine Geology, Marine Geophysical Researches)  
Lucchi (Ed. Board Arktos)  
Tinivella (Ed. Board of: Geofluids)  
Carcione (Assist. Ed BGTA, Ass. Ed. Journal of Seismic Exploration, Italian Journal of Geophysics.)  
Poletto (Ass. Ed. Journal of Seismic Exploration)  
Volpi (BGTA)  
Civile, Ceramicola (Ed. Ass. Marine Petroleum Geology)

## Teaching

Master Level Course in Marine Geology at the University of Trieste

Master Level Theses supervision (University of Trieste)

## PhD

- Earth Science and Fluid Mechanics, of the University of Trieste in collaboration with OGS and ICTP
- Science and Management of Climate Change, of the University Ca Foscari in Venice (will become Doctorate school in Polar Science)

## BILANCIO SEZIONE GEO

k Eur



	2014	2015	2016	2017	2018	2019
RICERCA ISTITUZIONALE	1.465	225	690	1.454	926	
RICERCA FINALIZZATA	178	246	242	93.9	104	
SERVIZIO CONTO TERZI	19	0	0	16.5	142	
totale	1.662	471	932	1.565	1.172	1.156

Average 1.160

# Altre infrastrutture di ricerca

OGS partecipa a numerose ulteriori infrastrutture ESFRI assieme a diversi enti nazionali ed inoltre gestisce direttamente importanti infrastrutture/laboratori, quali:

- la Banca di ceppi marini;
- il Centro di Taratura e Metrologia Oceanografico (CTMO);
- l'infrastruttura di geofisica sperimentale e di esplorazione;
- i Sistemi osservativi a terra ed a mare;
- il sito test geofisico di Piana di Toppo;
- la stazione glider;
- il velivolo da ricerca.

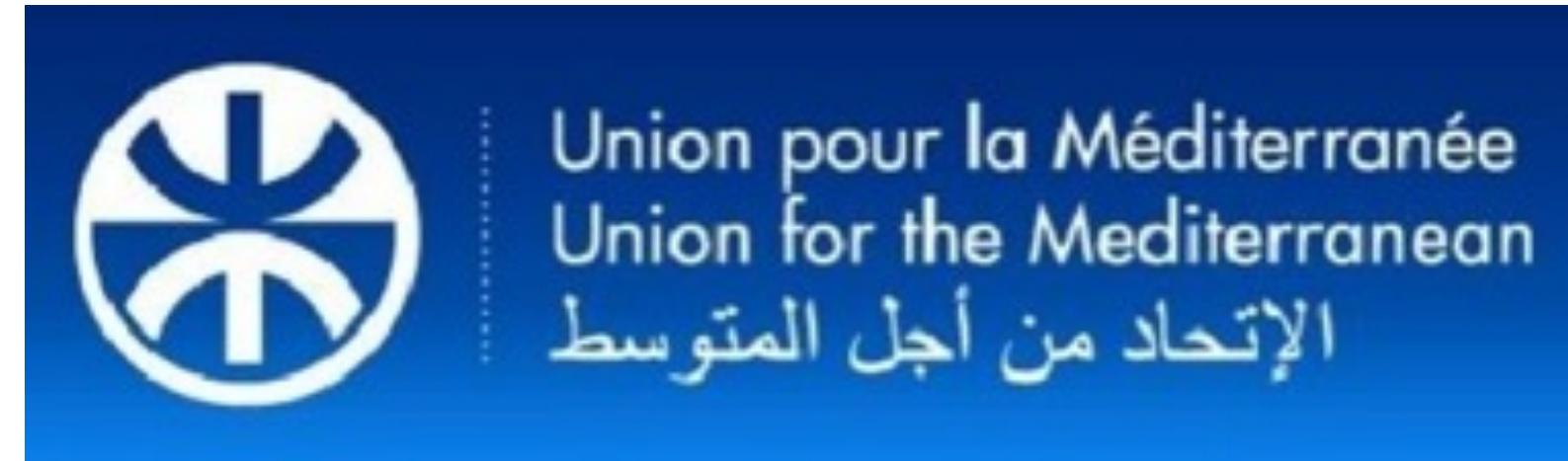
Piattaforme di gestione dati di OGS a carattere istituzionale e a completa disposizione della comunità scientifica:

- il National Oceanographic Data Centre (NODC);
- l'Antarctic Seismic data Library System (SDLS);
- il Seismic dataset Network Acces Point (SNAP);
- la banca dati geodetici (OGDB);
- le Reti di Monitoraggio sismico, accelerometrico e GPS nell'Italia Nord-Orientale, gestite in convenzione con i servizi di Protezione Civile di Regioni e Province autonome.

# Internazionalizzazione

La vocazione internazionale di OGS si realizza attraverso:

- la partecipazione e promozione di progetti e collaborazioni di ricerca a carattere internazionale;
- la partecipazione e promozione di servizi alla ricerca a carattere internazionale, in particolare con il comparto privato;
- la gestione ed il potenziamento delle infrastrutture di ricerca;
- lo sviluppo di una migliore capacità di attrazione di talenti internazionali;
- la partecipazione a reti di ricerca, associazioni e consorzi anche per rispondere in maniera coordinata alle chiamate dei programmi europei.



## Dialogo euro-Mediterraneo 5+5



Scuola di alta formazione “Sustainable Blue Growth in Mediterranean and Black Sea countries”



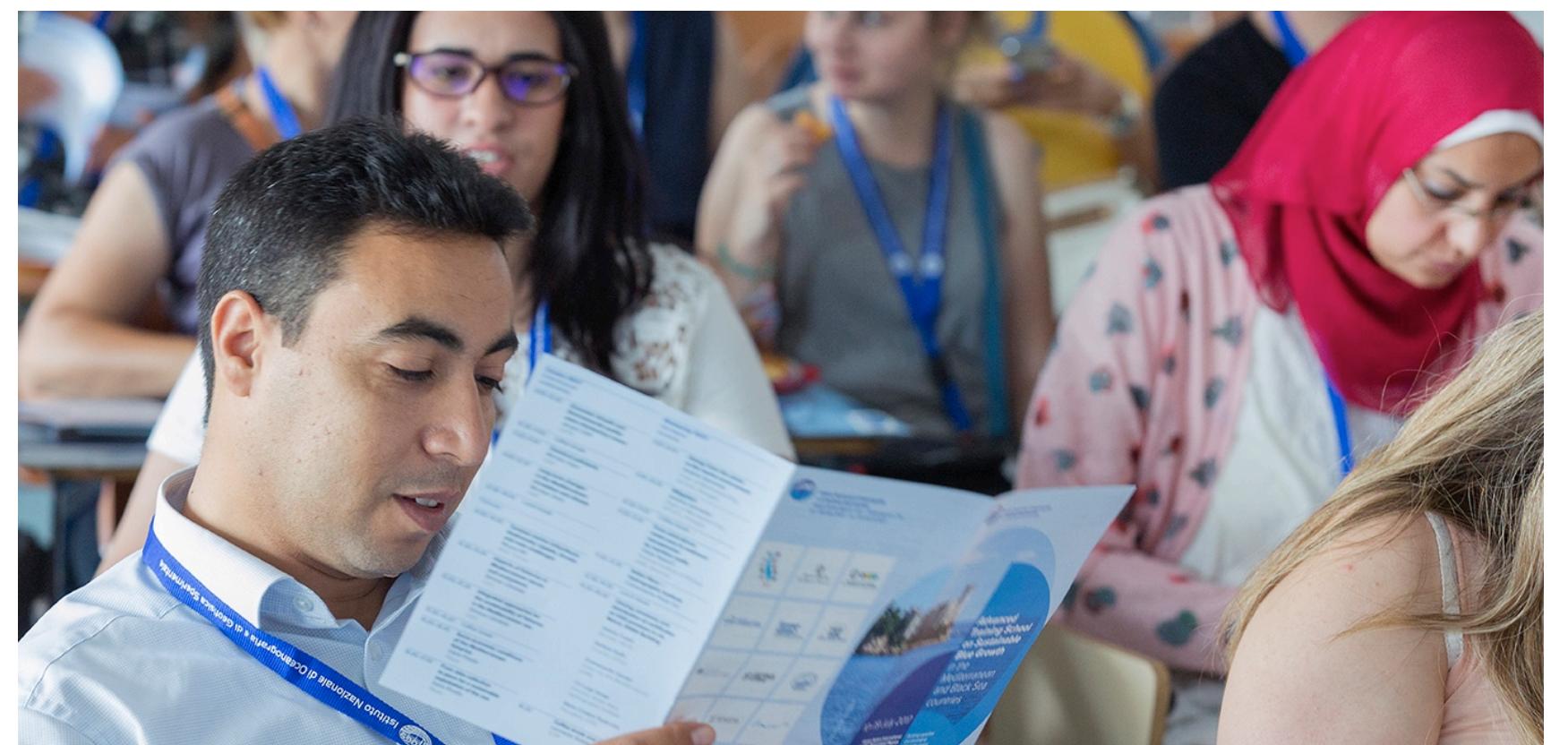
Summer School



Master internazionale di II livello attivato con l’Università di Trieste in “Sustainable Blue Growth”



Advanced Master



# Attività di divulgazione

OGS è da sempre impegnato in attività di promozione della cultura scientifica attraverso attività quali:

- Open Day
- Caffè delle Scienze
- Conferenze pubbliche
- Incontri con le scuole
- Notte dei Ricercatori e festival scientifici (Trieste NEXT)

