Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

Università degli studi di Trieste

LAUREA MAGISTRALE IN GEOSCIENZE

Classe Scienze e Tecnologie Geologiche

Curriculum: Esplorazione Geologica

Anno accademico 2023 - 2024

Analisi di Bacino e Stratigrafia Sequenziale (426SM)

Docente: **Michele Rebesco**

Modulo 1.1

Presentation
OGS
Laura Bassi
University of Parma: Emiliano Mutti
Scientific publications
The job of the geologist
Geoscience Canada: David Mosher
EOS: paths to a sceintific career
Introduction to sedimentary basins
Basic concepts of Basin Analysis
Structure of the course
Final Exam

Presentation: who are we?

Name:	**Michele Rebesco (mrebesco@inogs.it)**
Education:	**Phd in Earth Sciences in 1996 @University of Parma**
Years of experiences :	**30 years following M.Sc. Degree in geological sciences**
Current job title:	**Senior researcher, geophysics department**
My job in a few words:	**geological exploration of polar continental slopes**

Research and Academic or professional Experiences

- 30 years of experience as marine geologist in deep sea clastic sedimentary processes
- Editor-in-Chief of the journal "Marine Geology" since 2014 and previously editorial board member
- Professor at the University of Trieste for the Marine Geology course and Earth Science PhD course
- Chair of the Scientific Liaison Panel of the EU ARICE "Arctic Research Icebreaker Consortium"

An achievement I am willing to share

- Understanding along-slope versus down-slope and interacting sedimentary processes
- Evaluation of scientific manuscripts, research proposals and applications for marine survey and drilling

my personal interests outside work

- Travelling, Trekking, Climbing, Swimming, Reading…

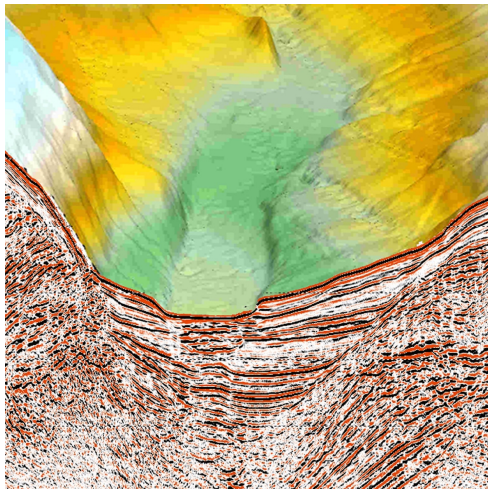
OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

National Institute of Oceanography and Applied Geophysics

Nicola Casagli, President

OGS institutional activity

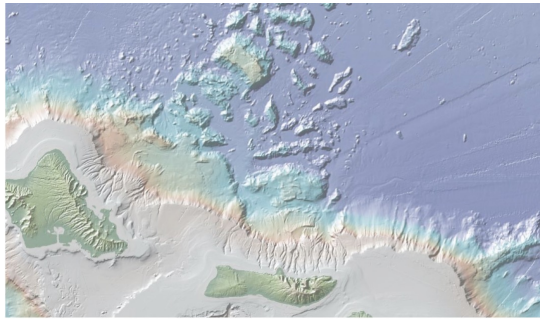
Oceanography
physical, chemical, biological and geological



Geophysics
experimental and exploration

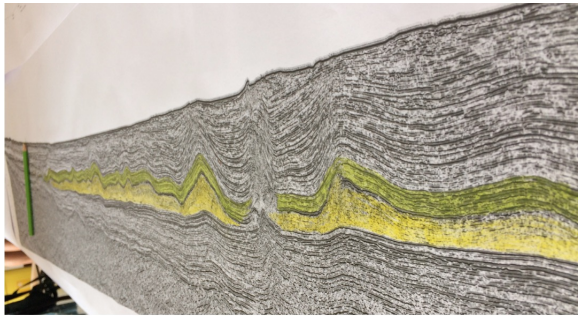
Seismology
and Engineering Seismology

R&D missions



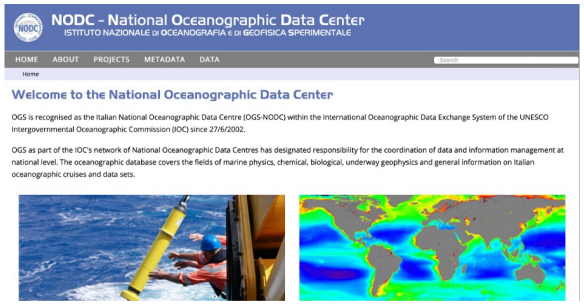
Seas & Oceans

Natural Hazards



Earth Interior

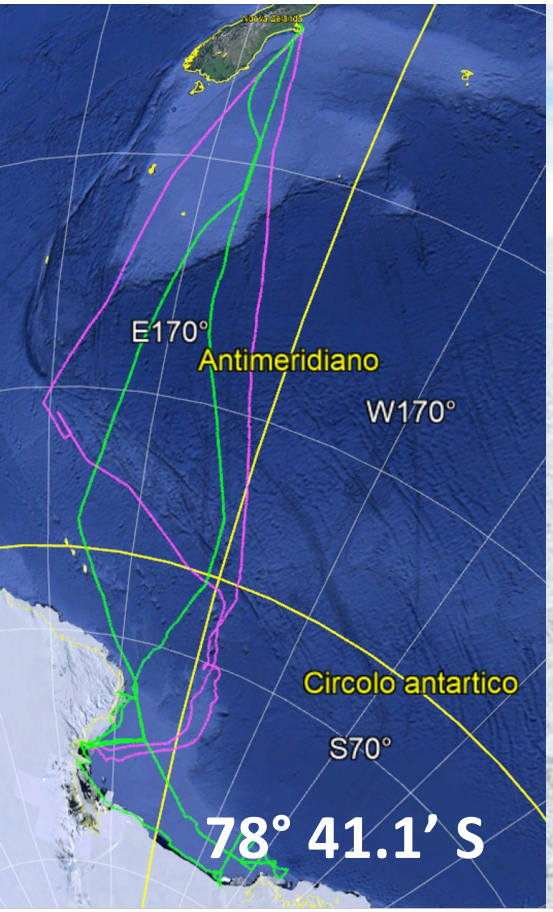
Polar Areas



Open Science

R/V Laura Bassi

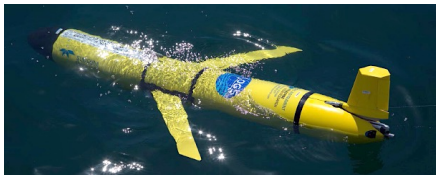
Antarctic and Arctic missions since 2019



European Research Infrastructures

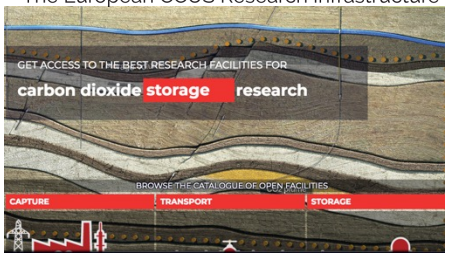
coordinated by OGS
on behalf of the Italian government

Euro Argo ERIC



International program that uses profiling floats to observe oceans
www.euro-argo.eu

eccsel eric
The European CCUS Research Infrastructure



European Carbon Dioxide Capture and Storage Laboratory Infrastructure
www.eccsel.org

PRACE

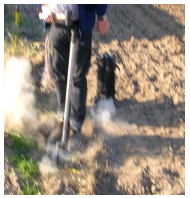
Partnership for Advanced Computing in Europe
www.prace-ri.eu

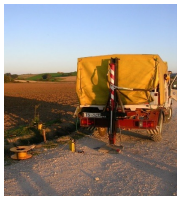
European Strategy Forum on Research Infrastructures ESFRI

Other research infrastructures

- **Research aircraft**
  Piper PA-34-220 T Seneca III marche I-LACA

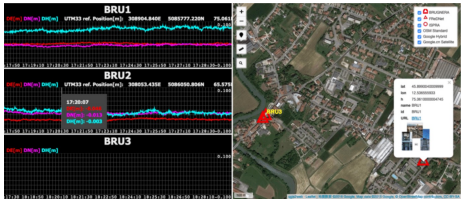
- **Exploration geophysics infrastructure**
  - seismic surveys
  - georesistivity
  - magnetometry
  - georadar
  - multi-beam echo sounders
  - sub-bottom-profilers (chirp and boomer)
  - side-scan-sonar
  - GNSS receivers

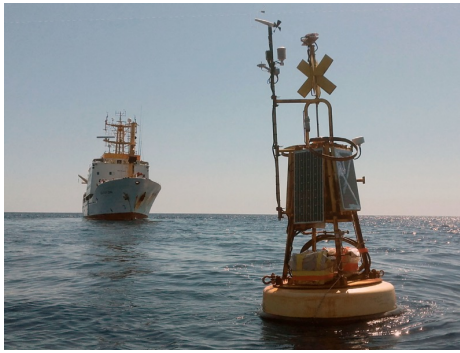


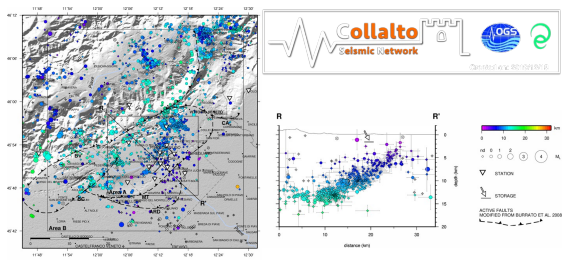


Observatories

- Antarctic Seismographic Argentinean Italian Network (ASAIN)
- Seismic Mobile Lab
- Seismic monitoring of industrial activities
- GNSS monitoring of landslides
- Deep-sea observatory SAILOR/E2-M3A
- Trieste Gulf Observatory
- Radar Observatory of Capo Granitola
- Glider station

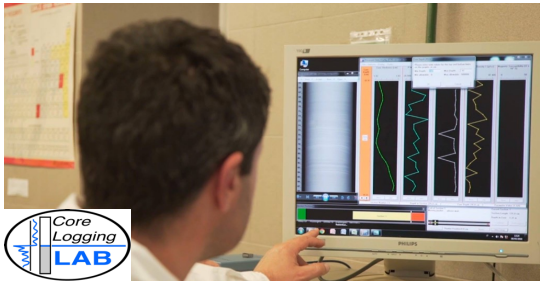


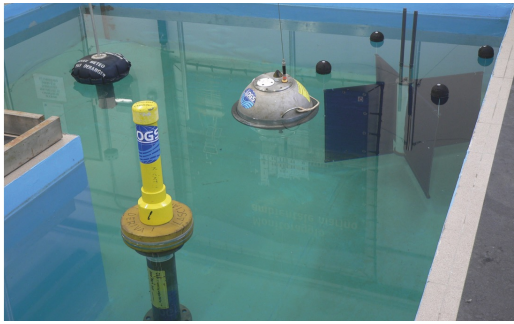




Test sites and laboratories

- Geophysical test site of Piana di Toppo (PITOP)
- Multi-Sensor Core Logger Lab
- SEISLAB Virtual Lab
- BioMarine Lab
- Oceanography Labs
- Earth and Marine Geology Labs

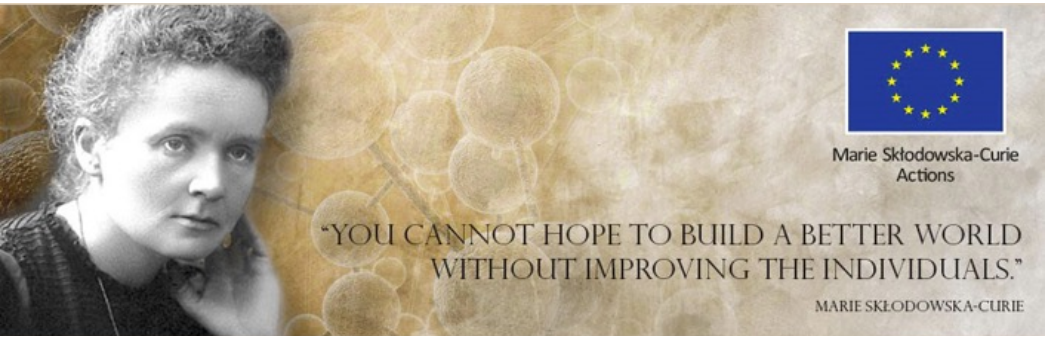




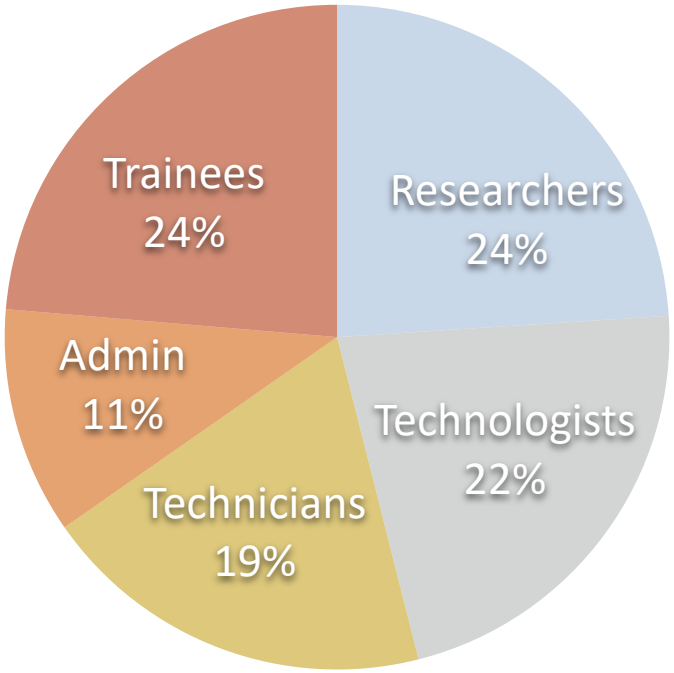
Calibration and test centers

- Oceanographic Calibration and Metric Centre (CTMO)
- Seismologic Calibration Center
- Glider Calibration Center

Human Resources



- 325 people in total (145 scientists & 103 administratives)
- 210 with permanent position
- 40 temporary position
- 75 are young trainees (fellows and doctoral students)



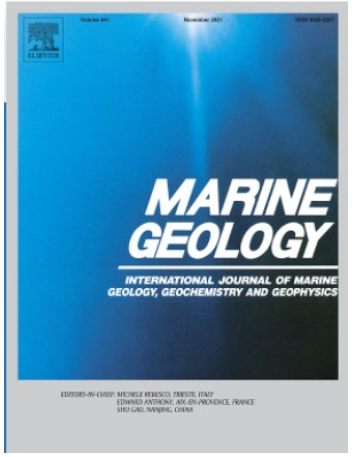
Where I come from: University of Parma

https://www.youtube.com/watch?v=E3Lg0UQwuQU

Emiliano Mutti - Eni Award 2016

What do I do?

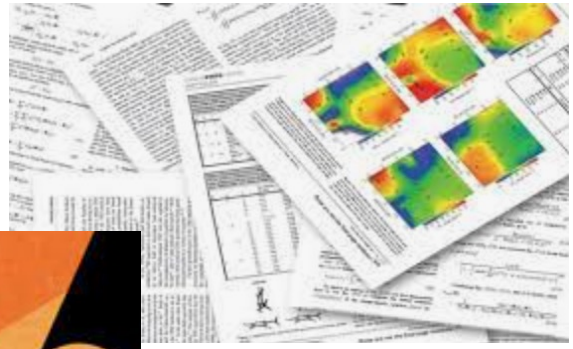
- 30 years at the poles
  (6 times Antarctica, 2 Arctic)



- Since 8 years Editor-in-Chief of «Marine Geology»

- Vice-coordinatore GEV VQR 2015-2019

Scientific production

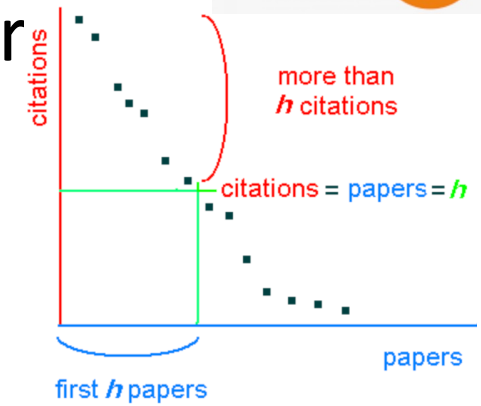


- Scientific papers
- ORCID
- Peer review
- Plagiarism
- Data banks
- Open Access
- Impact Factor
- H-index

ORCID
stands for
Open Researcher and Contributor ID

Scopus

OPEN ACCESS



2020 JIF = $\frac{\text{Citations in 2020 to items published in 2018 + 2019}}{\text{Number of citable items published in 2018 + 2019}}$

Citation example:

Rebesco, M., Hernández-Molina, F.J., Van Rooij, D., Wåhlin, A.

Contourites and associated sediments controlled by deep-water circulation processes: State-of-the-art and future considerations

Year: ???

Journal: ???

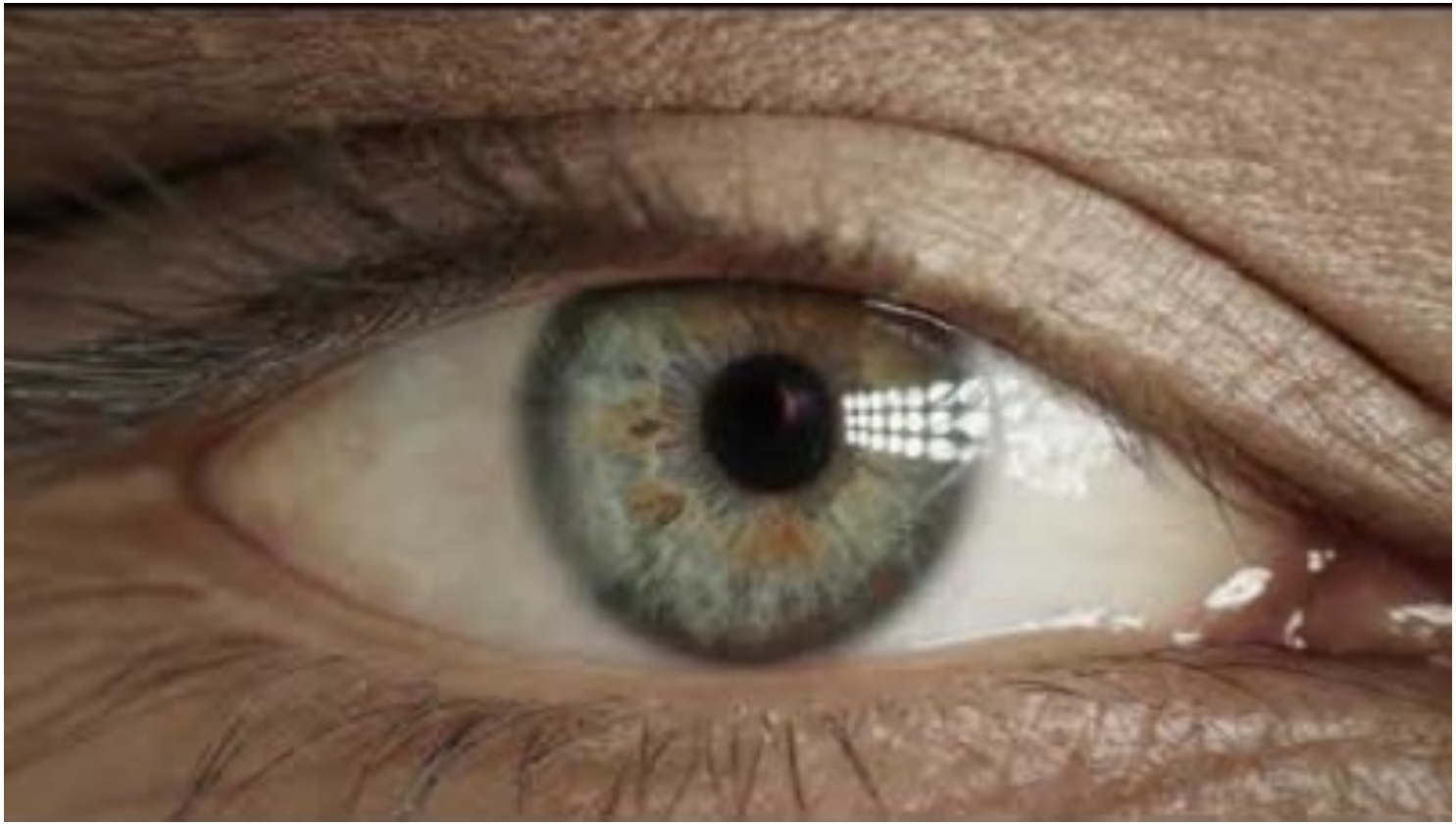
Volume: ??? Pages: ???

Cited: ??? times.

DOI: ???

Homework: find it!

…let's come back to geologists…



Società Geologica Italiana https://www.youtube.com/watch?v=dN11usDFLyc

David Mosher

I think the geoscientist is in a unique position with regard to pressures facing society today, such as climate change and resource shortages. We understand more than others the way the Earth works and what it has endured up until now.

Through tackling tectonic, structural and stratigraphic problems, we learn to think not only in 3 dimensions (a few other professions, such as architecture may do the same), but we learn to think in the fourth dimension as well – TIME. No other profession does that as we do. As John McPhee says in the Annals of the Former World,"…*with their 4 dimensional minds and their interdisciplinary ways, geologists can wriggle out of almost anything*."
I think this knowledge and these abilities empower us to create solutions. As Wendell Barry, American Author, said, "The Earth is what we all have in common."

https://csegrecorder.com/interviews/view/interview-with-david-mosher


WE LEARN GEOLOGY THE MORNING AFTER AN EARTHQUAKE
RALPH WALDO EMERSON

Charting the Paths to a Scientific Career

In our special issue on STEM careers, meet 17 scientists who've forged creative paths to a rewarding pursuit of Earth and space science

https://eos.org/agu-news/charting-the-paths-to-a-scientific-career

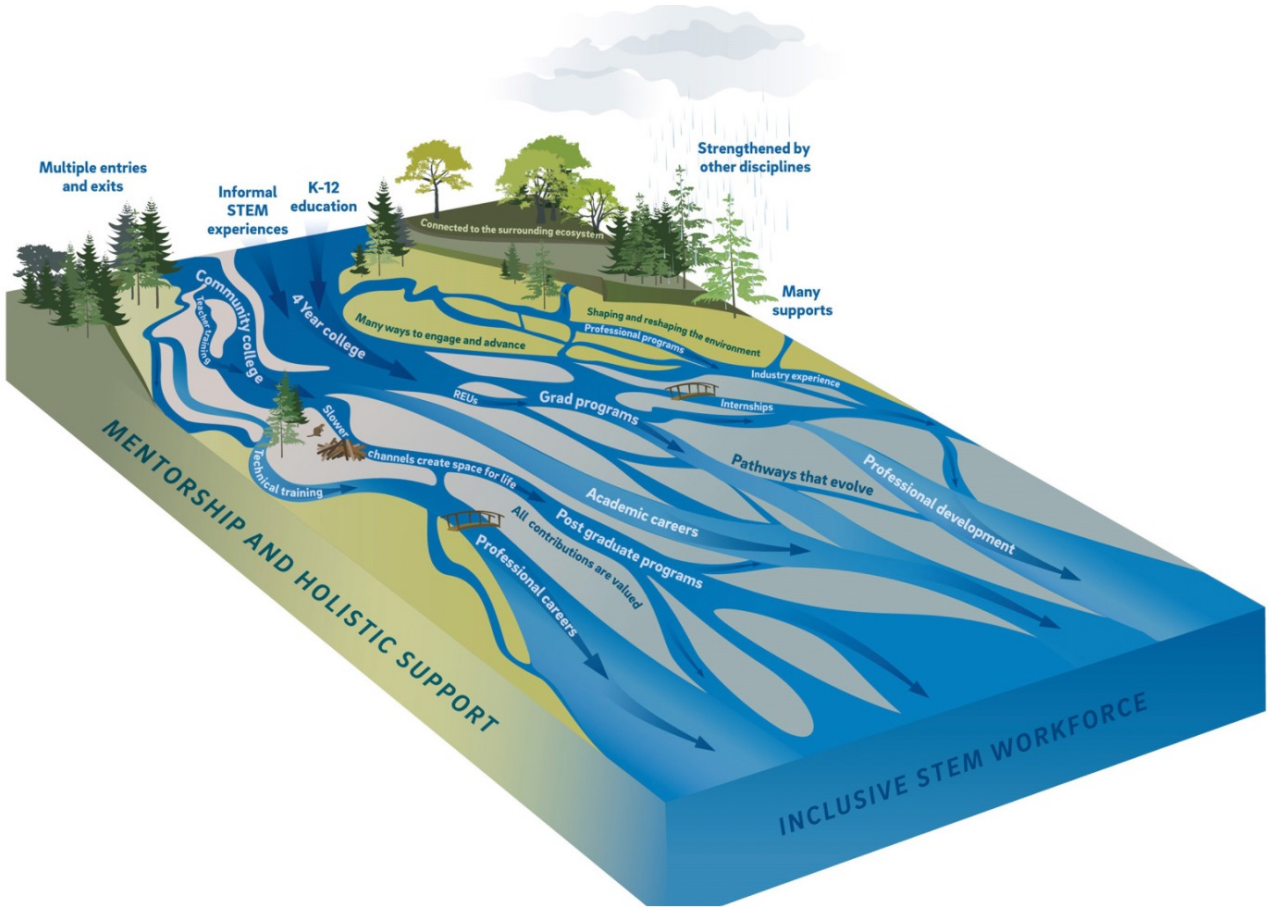
Fushcia-Ann Hoover is that small business owner who took her education in science and engineering and her passion as a “maker” and used them to launch an organization that offers consultation to communities on urban green infrastructure

Kristel Chanard dreamed of Himalayan expeditions.

Today she’s checked off the Himalayas, the French Alps, and so many more summits to conduct her work as a research geophysicist for an institute in Paris

Zdenka Willis, our military veteran, loved the challenge of transitioning the Navy to digital charts and went on to become the president of an international society that brings businesses, policymakers, educators, and others together to advance marine technologies.

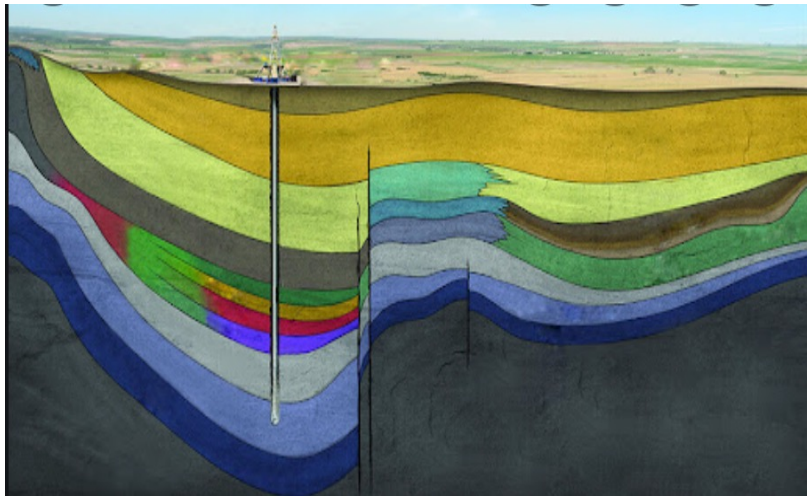
A braided river system illustrates a new, holistic STEM workforce career development model.



Credit: Jennifer Matthews

https://eos.org/opinions/reimagining-stem-workforce-development-as-a-braided-river

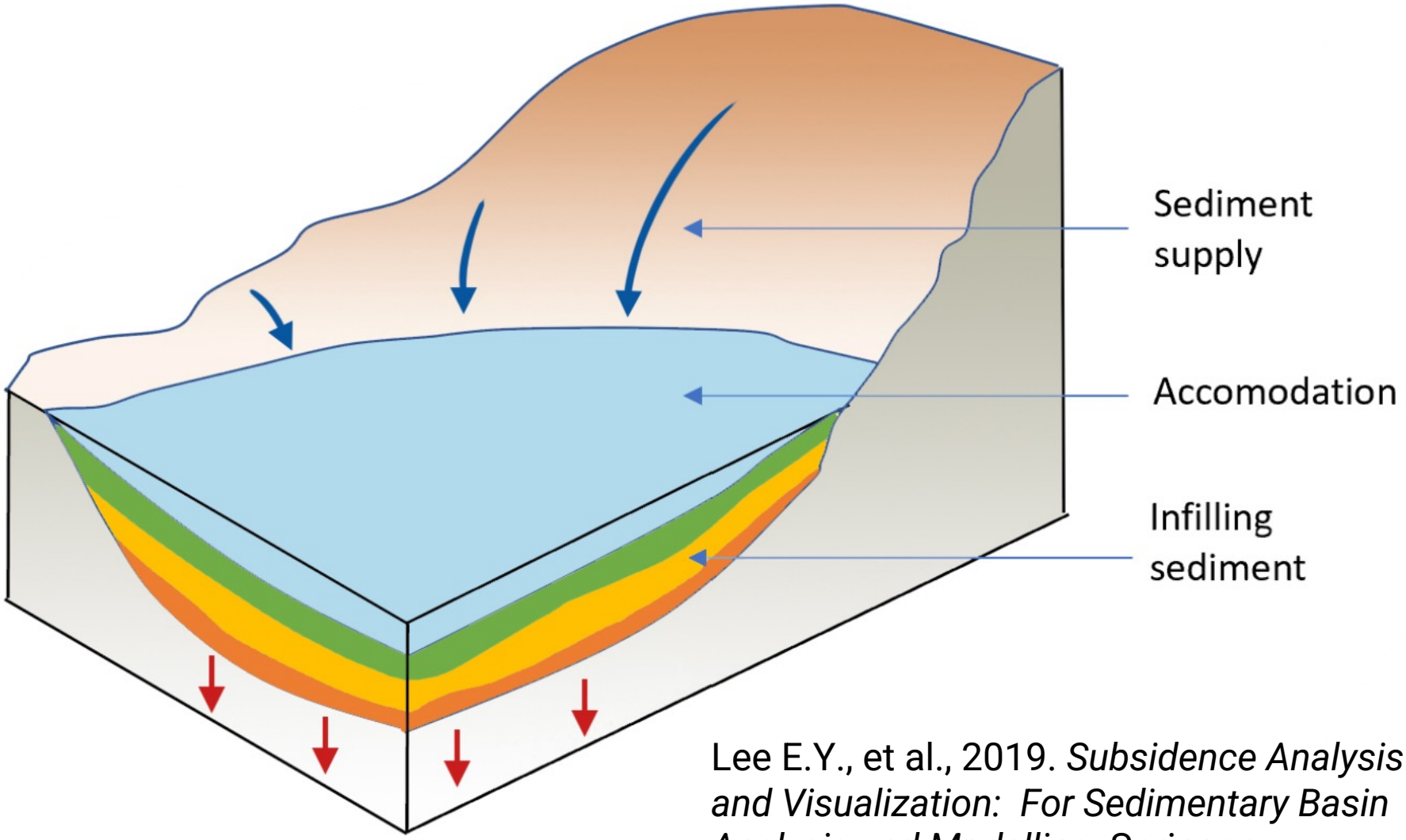
Applications (geology in general, but above all basin analysis):



Paleo-environmental reconstruction, natural resources
- hydrocarbons,
- Energy storage
- Geothermy
- Deep-Sea mining
- Carbon Capture Use and Storage
- …

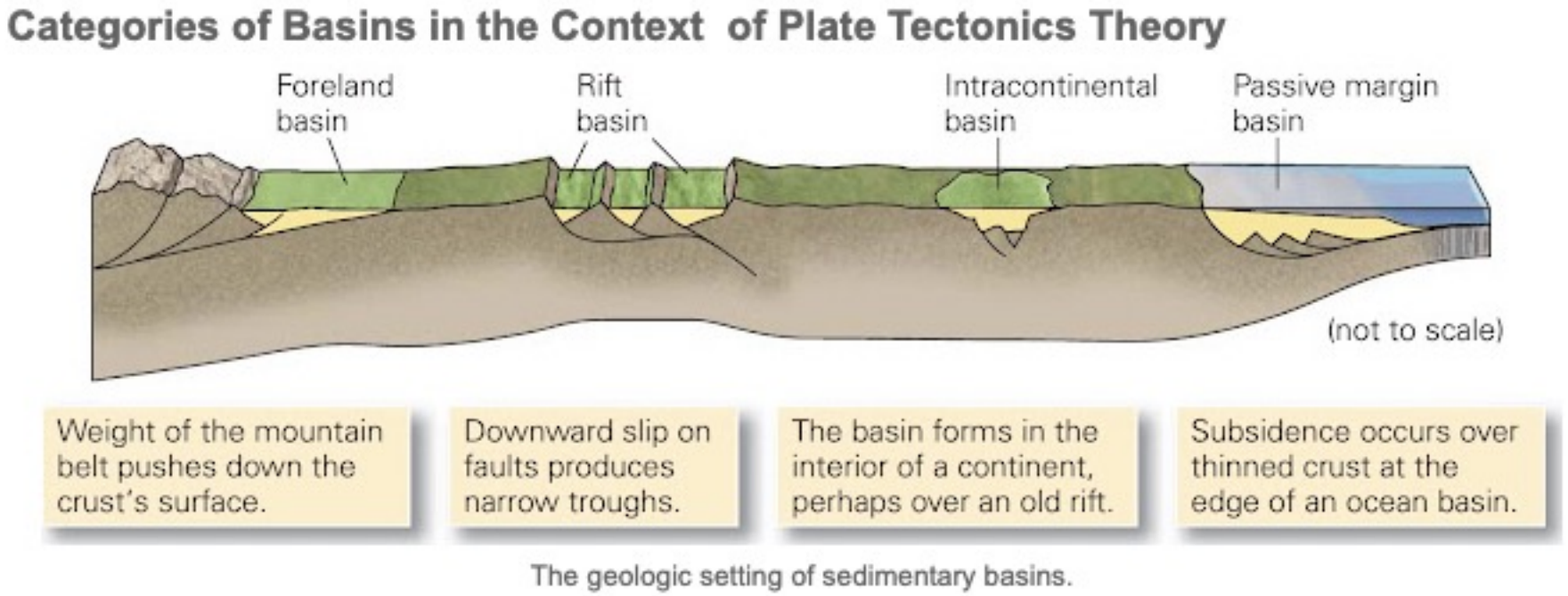
In China for example. they are investing heavily in geology degree programs. For development, the dangers of the territory, etc ...

Sedimentary basins



Lee E.Y., et al., 2019. *Subsidence Analysis and Visualization: For Sedimentary Basin Analysis and Modelling*. Springer

Mechanisms of basin formation (1 lesson), Emanuele Lodolo



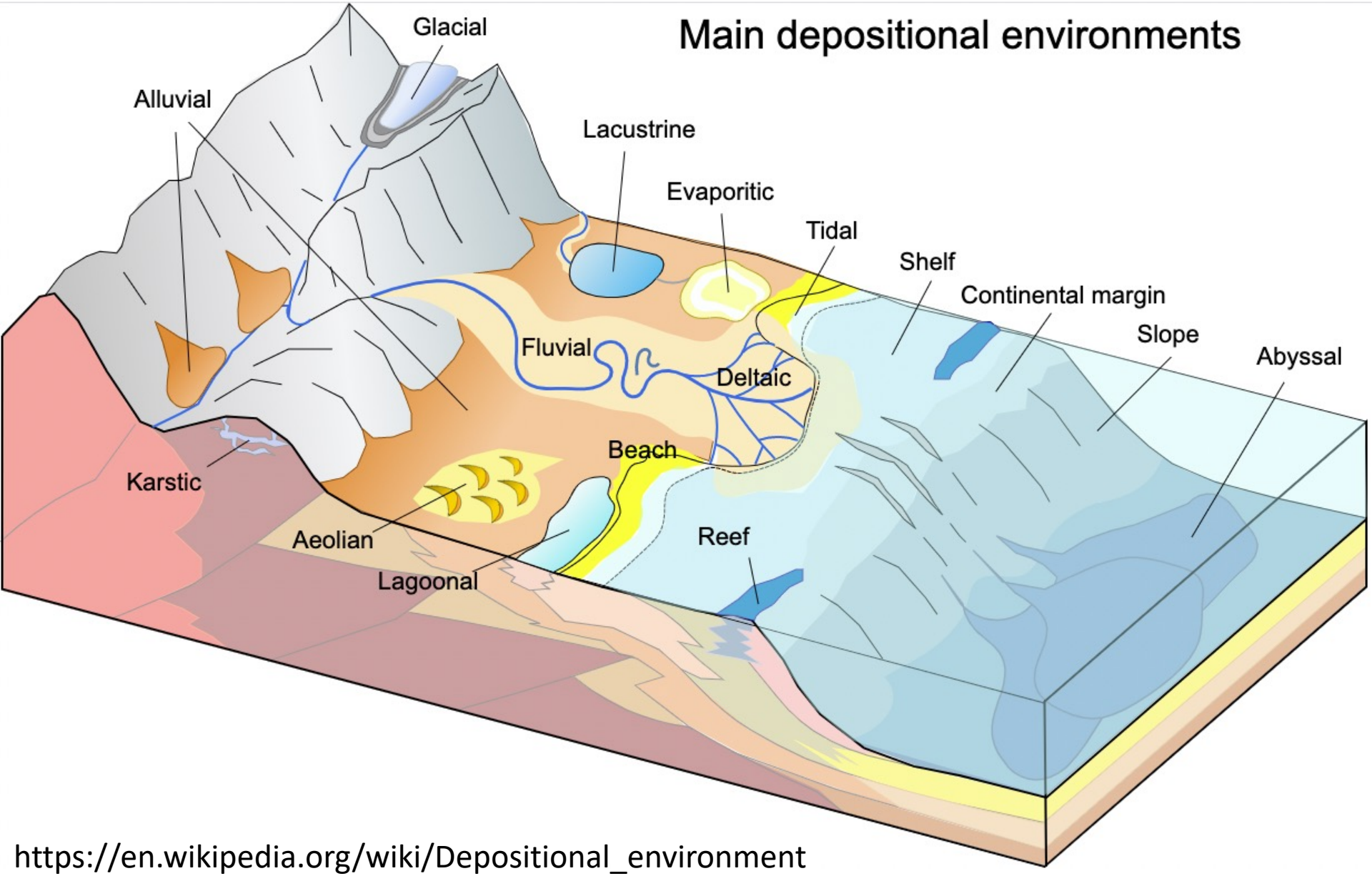
The geologic setting of sedimentary basins.

Credits: Stephen Marshak (Essentials of Geology)
http://geologylearn.blogspot.com/2016/03/sedimentary-basins.html

Sedimentary basin analysis *(from Wikipedia)*

Sedimentary basin analysis is a geologic method by which the formation and evolution history of a sedimentary basin is revealed, by analyzing the sediment fill and subsidence.
Aspects of the sediment, namely its composition, primary structures, and internal architecture, can be synthesized into a history of the basin fill. Such a synthesis can reveal how the basin formed, how the sediment fill was transported or precipitated, and reveal sources of the sediment fill.

Petroleum industry basin analysis is often conducted on subterranean basins through the use of reflection seismology and data from well logging.
Academic geologists sometimes use petroleum industry techniques, but in many cases they study surficial sedimentary rocks: measuring stratigraphic sections, identifying sedimentary depositional environments and constructing a geologic map.
(see the lesson on the methods)



https://en.wikipedia.org/wiki/Depositional_environment

Sequence Stratigraphy *(from Wikipedia)*

An important tool in sedimentary basin analysis is sequence stratigraphy, in which various sedimentary sequences are related to pervasive changes in sea level and sediment supply.

Sequence stratigraphy is a branch of geology that attempts to subdivide and link sedimentary deposits into unconformity bound units on a variety of scales and explain these stratigraphic units in terms of variations in sediment supply and variations in the rate of change in accommodation space (relative sea level, the combination of eustatic sea level and tectonic subsidence).

The essence of the method is mapping of strata based on identification of surfaces which are assumed to represent time lines (e.g. subaerial unconformities, maximum flooding surfaces), and therefore placing stratigraphy in chronostratigraphic framework. Sequence stratigraphy is a useful alternative to a lithostratigraphic approach, which emphasizes similarity of the lithology of rock units rather than time significance.

I introduce these concepts in the lesson on methods and in the lesson on interpretation
While the Sequence Stratigraphy is treated at the end of the course

Final exam

Knowledge and understanding:
knowledge and ability to understand the key concepts and fundamental principles of basin analysis and sequence stratigraphy oriented towards paleoenvironmental reconstructions and exploitation of resources.

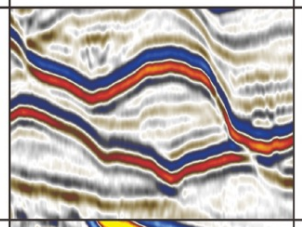
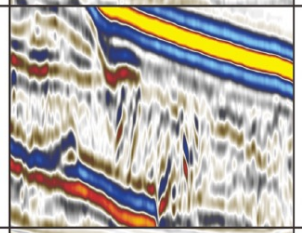
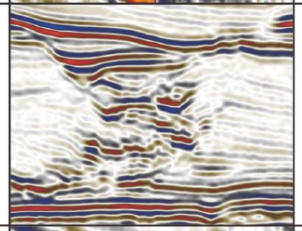
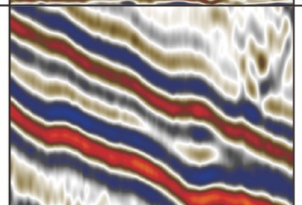
Applying knowledge and understanding:
knowing how to delineate unconformities and system tracts, especially in seismic reflection data; knowing how to distinguish primary structures; being able to distinguish facies and geometries (especially in seismic reflection data but also in outcrops).

Making judgments:
knowing how to apply the knowledge acquired to formulate an interpretation about sedimentary processes and depositional environments, especially in seismic reflection data.

Communication skills:
ability to effectively use during a critical discussion, with appropriate and specific language and certainty of presentation, the concepts learned during the course

Learning skills:
demonstrate to be able to apply the minimum knowledge, skills and competences acquired and independently deepen the topics covered in order to be able to transfer the notions learned in subsequent courses

- **First part: discussion of your report of the exercise at the end of the course**
- **Second part: discussion of an example taken from a scientific paper**

Seismic Facies	Characteristics	Seismic images	Sediment elements
SF1	High amplitude, wavy continuous top, medium amplitude, sub-parallel inner reflection. Smooth and thick at stoss side, steep at lee side.		Sediment wave
SF2	Chaotic dim reflection, interbedded with discontinuous high amplitude reflection, with high amplitude top. Sharp base and top, clear boundary with surrounding strata.		Debrites
SF3	HAR packages, interbedded with dim reflection, sharp boundary with surrounding strata, vertical aggradation and lateral migration.		Channel fill
SF4	Parallel, continuous HAR interbedded with low amplitude reflection.		Pelagic-Hemipelagic sediment

Corso di **Analisi di Bacino e Stratigrafia Sequenziale**

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

Unit	*Topic*	*Teacher*	*Date*
1.1	Introduction to the course	Rebesco	25/09/23
1.2	Methods (geophysics, but not only)	Geletti/Rebesco	28/09/23
1.3	Mechanisms of basin formation (geodynamics, tectonics…)	Lodolo	02/10/23
1.4	Seismic interpretation, facies and primary structures	Rebesco	05/10/23
1.5	Energy storage & CCUS	Volpi/Donda	09/10/23
2.1	Sedimentary processes in river & deltas	Rebesco	12/10/23
2.2	Action of tides and waves, wind and ice	Rebesco	16/10/23
2.3	Density currents, bottom currents and mass transport	Lucchi/Rebesco	19/10/23
3.1	Alluvial deposits, lakes and deserts	Rebesco	23/10/23
3.2	Barrier systems and incised valleys	Rebesco	26/10/23
??	??	Rebesco	30/10/23
3.3	Continental shelves (wases, storms, tsunamis)	Rebesco	06/11/23
3.6	Submarine fans (gravity flows on the continental slope)	Lucchi	09/11/23
3.7	Sediment drifts (bottom currents along the continental slope)	Rebesco	13/11/23
3.4	Mass transport deposits	Ford	16/11/23
3.5	Abyssal plains (hemipelagic fallout) and continental margins	Rebesco	20/11/23
3.8	Glacial depositional systems	De Santis	23/11/23
3.9	Carbonatic environments, faults, volcans	Rebesco	27/11/23
4.1	Sequence stratigraphy: introduction	Rebesco	30/11/23
4.2	Sequence stratigraphy: closer view	Rebesco	04/12/23
4.3	Sequence stratigraphy: applications (e.g. hydrocarbon reservoirs)	Rebesco	07/12/23
6.1	Visit to CoreLoggingLAB (along with Geologia Marina)	Rebesco	11/12/23
5.1	Excercise (part 1)	Rebesco	14/12/23
6.2	Visit to OGS and SEISLAB (along with Geologia Marina)	Rebesco	18/12/23
5.2	Excercise (part 2)	Rebesco	21/12/23
	No lesson 23rd December till 7 th January		
??	??	Rebesco	08/01/24
??	??	Rebesco	11/01/24