



Università degli studi di Trieste

LAUREA MAGISTRALE IN GEOSCIENZE

Classe Scienze e Tecnologie Geologiche

Curriculum: Esplorazione Geologica

Anno accademico 2022 - 2023

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 scientific 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

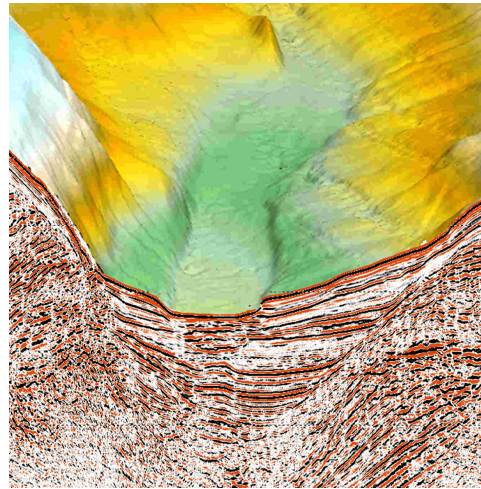


Nicola Casagli, President

OGS institutional activity



Oceanography
physical, chemical,
biological and
geological

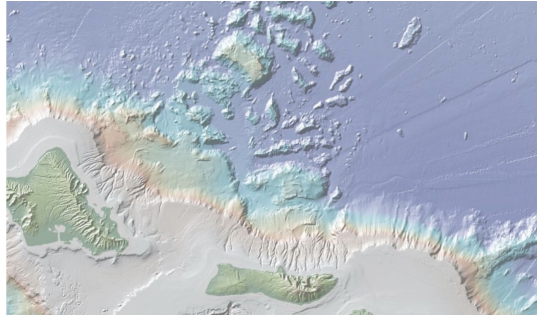


Geophysics
experimental and
exploration



Seismology
and Engineering
Seismology

R&D missions



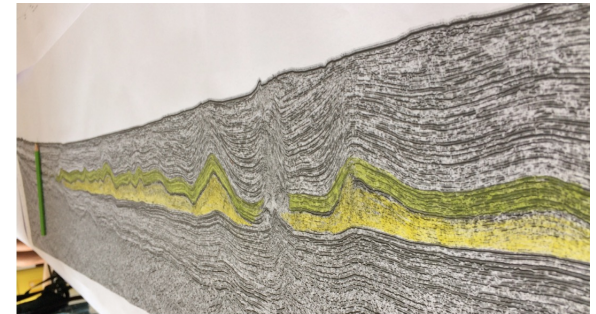
Seas & Oceans



Polar Areas



Natural Hazards



Earth Interior

NODC - National Oceanographic Data Center
ISTITUTO NAZIONALE DI OCEANOGRAFIA E DI GEOFISICA Sperimentale

HOME ABOUT PROJECTS METADATA DATA

Home

Welcome to the National Oceanographic Data Center

OGS is recognised as the Italian National Oceanographic Data Centre (OGS-NODC) within the International Oceanographic Data Exchange System of the UNESCO Intergovernmental Oceanographic Commission (IOOC) since 27/6/2002.

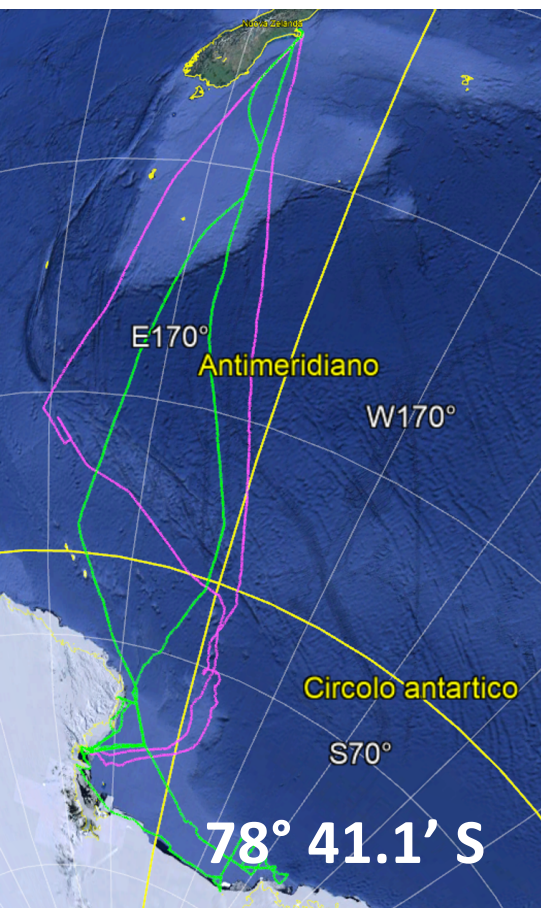
OGS as part of the IOC's network of National Oceanographic Data Centres has designated responsibility for the coordination of data and information management at national level. The oceanographic database covers the fields of marine physics, chemical, biological, underway geophysics and general information on Italian oceanographic cruises and data sets.

Open Science

R/V Laura Bassi

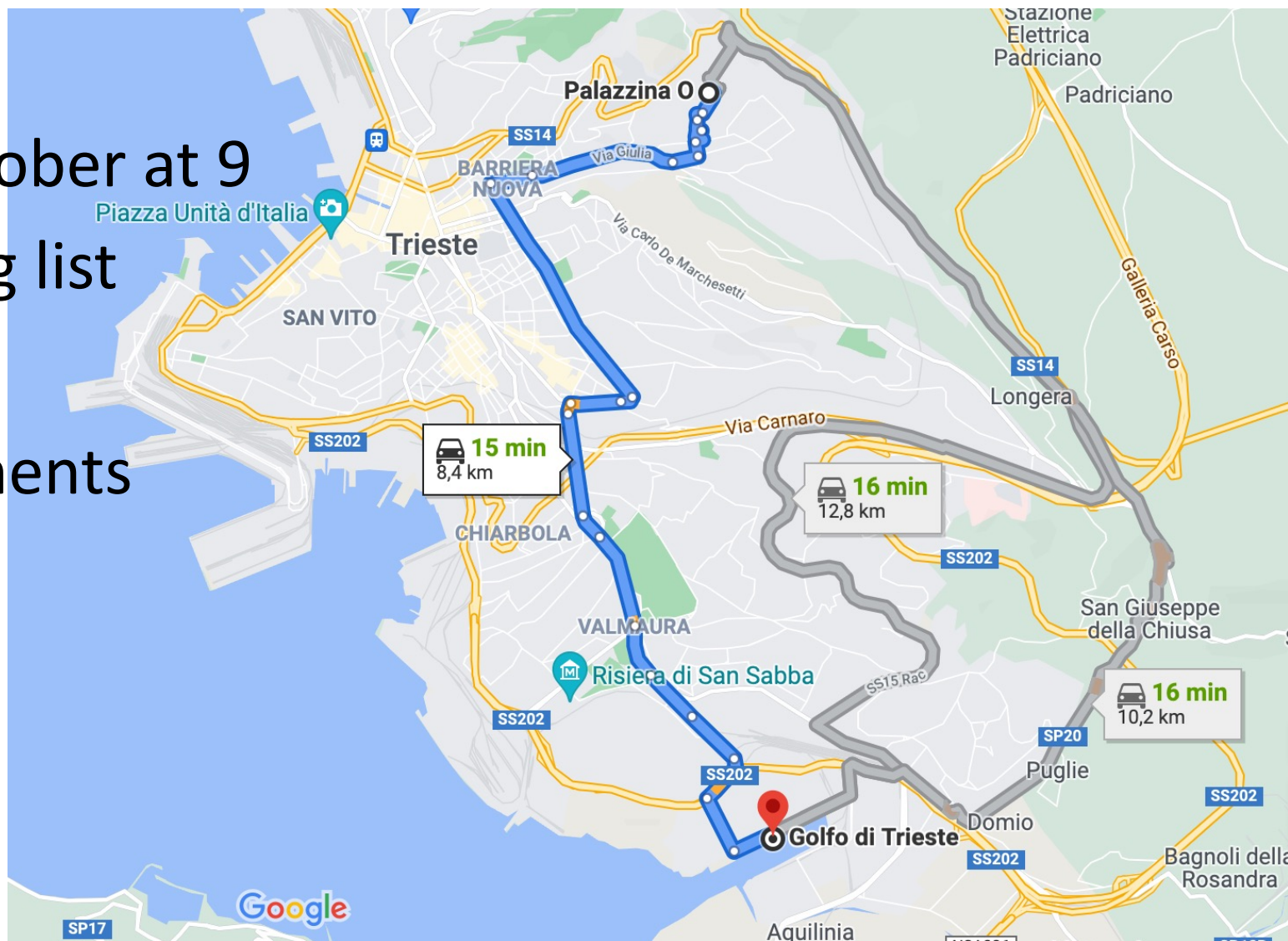


Antarctic and Arctic missions since 2019



Visit to LAURA BASSI

- 10 October at 9
- Mailing list
- cars
- Documents



European Research Infrastructures

coordinated by OGS
on behalf of the Italian government



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



The European CCUS Research Infrastructure



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



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



European Strategy Forum on Research Infrastructures

ESFRI

Other research infrastructures

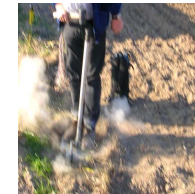
- **Research aircraft**

Piper PA-34-220 T Seneca III marche I-LACA



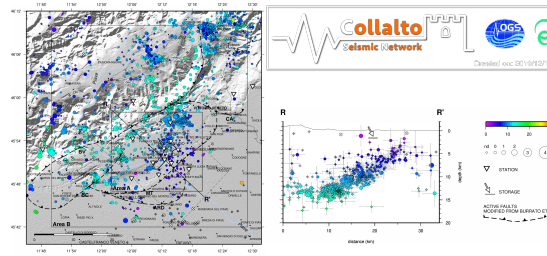
- **Exploration geophysics infrastructure**

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



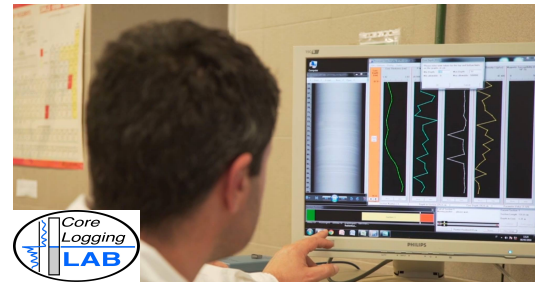
Observatories

- 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



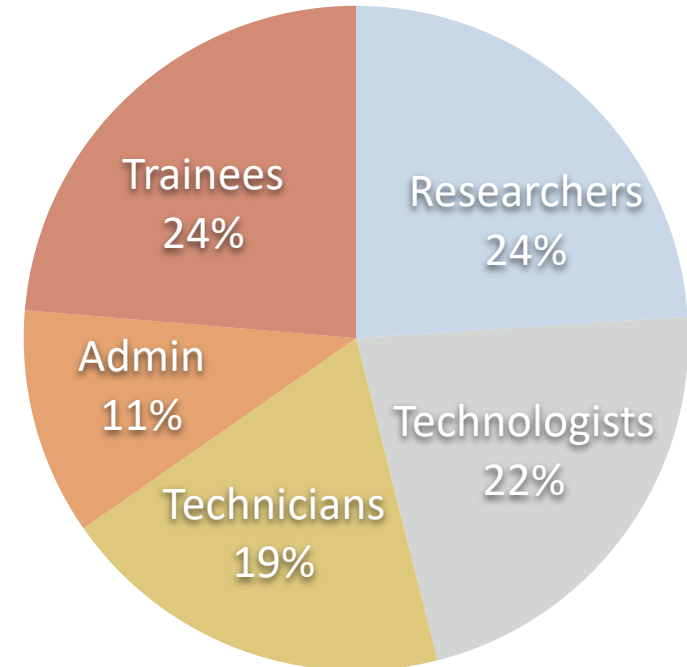
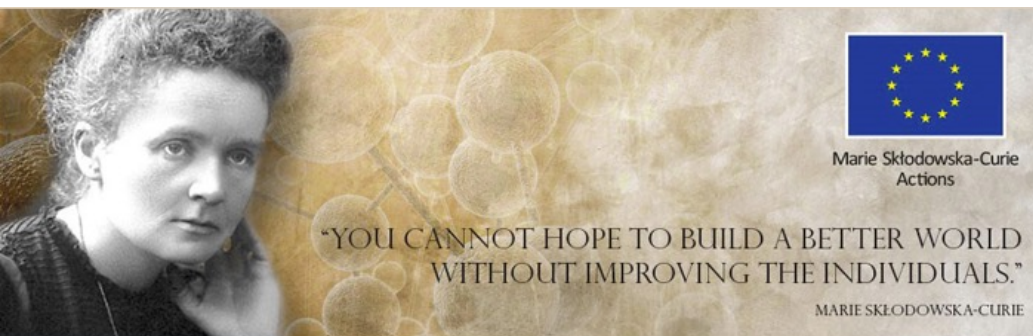
Calibration and test centers

- 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>

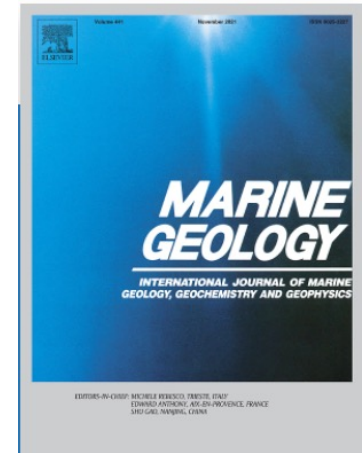
Emiliano Mutti - Eni Award 2016





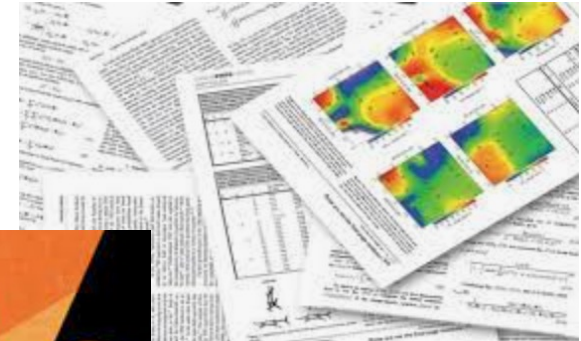
What do I do?

- 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

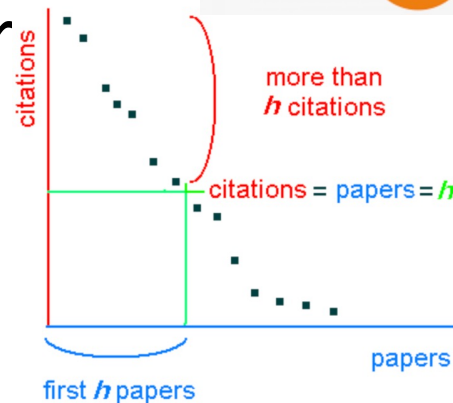


Scientific production

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



Scopus



2020 JIF =

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

Citation example:

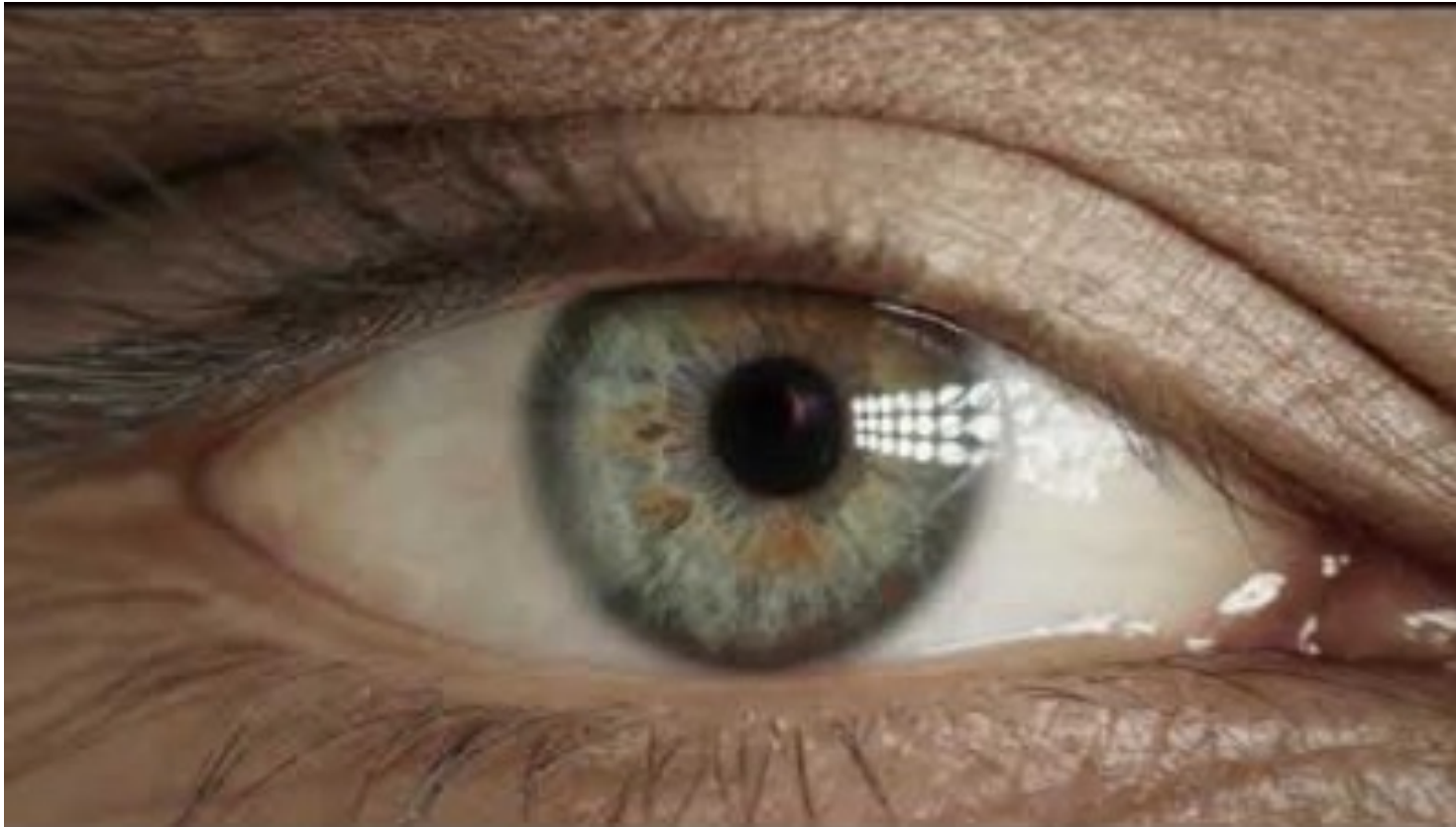
Rebesco, M., Camerlenghi, A., Munari, V., Mosetti, R., Ford, J., Micallef, A., Facchin, L.
(2021)

Bottom current-controlled Quaternary
sedimentation at the foot of the Malta Escarpment
(Ionian Basin, Mediterranean).

Marine Geology 441, 106596

Homework: find it!

...let's come back to geologists...



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

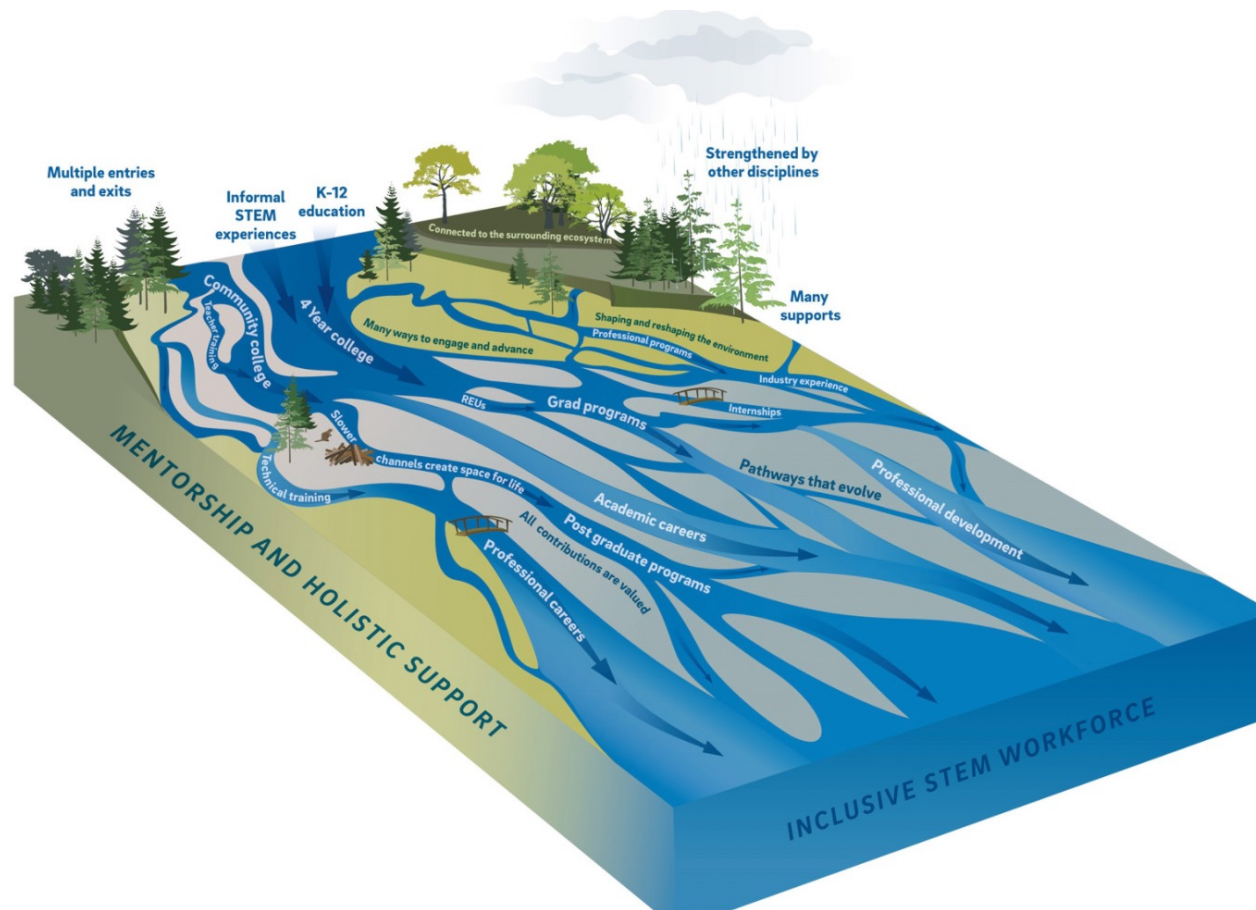
Kristel Chanard dreamed of Himalayan expeditions.

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.



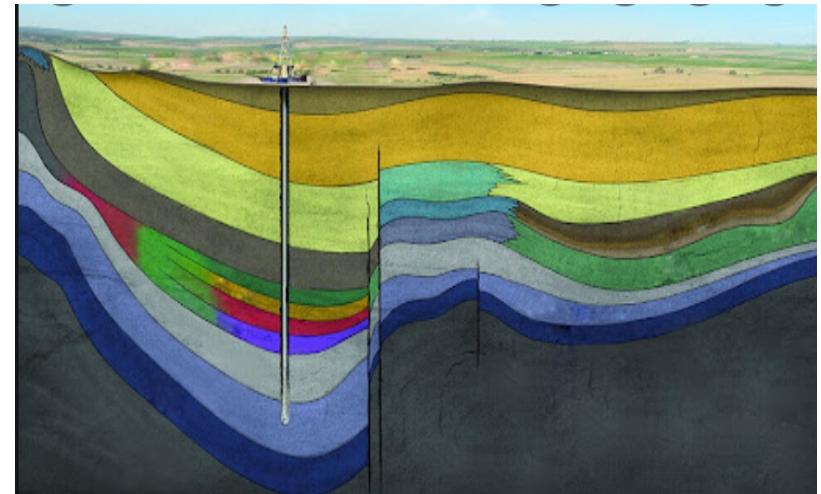
Credit: Jennifer Matthews

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

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

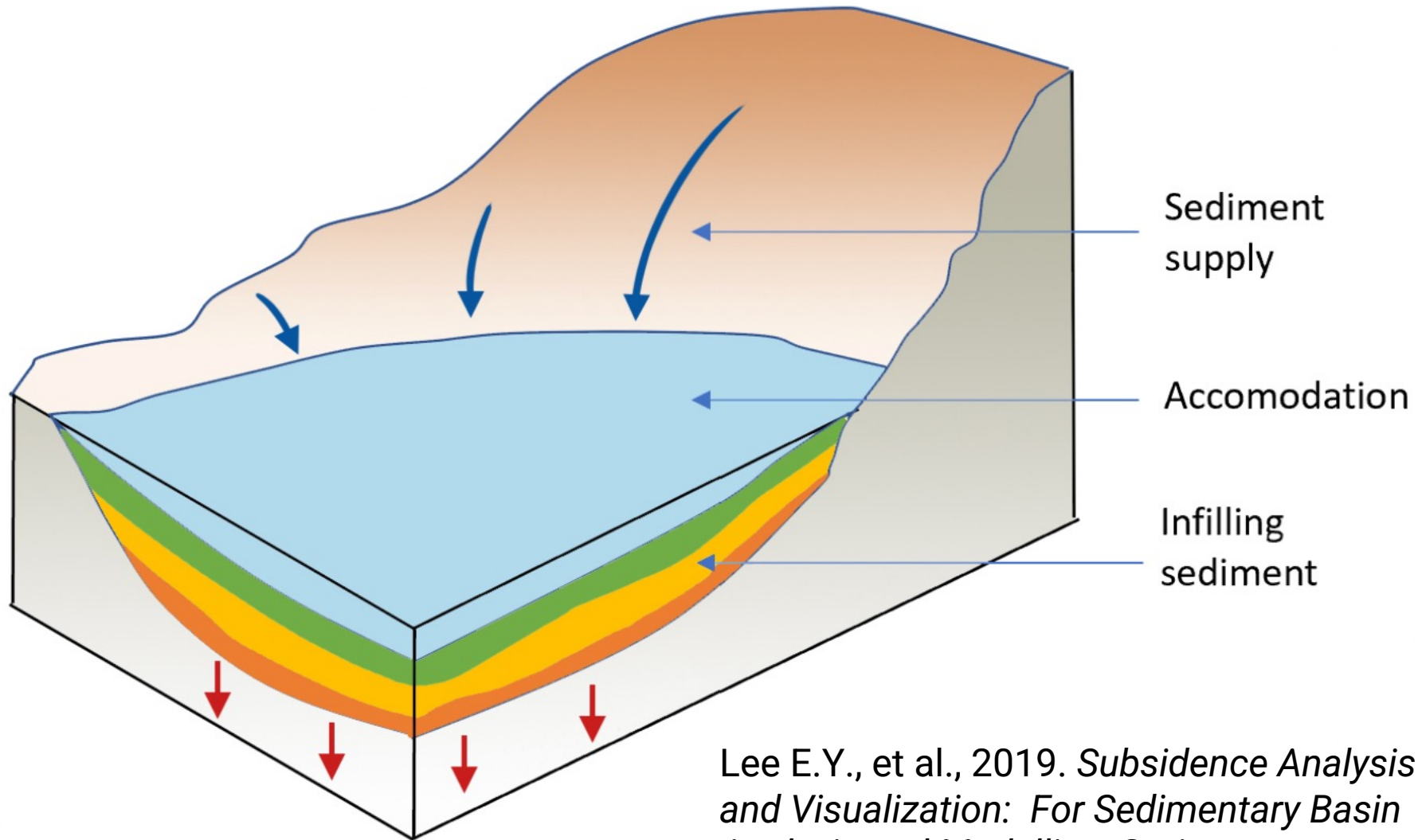
Paleo-environmental
reconstruction, natural resources

- 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 ...

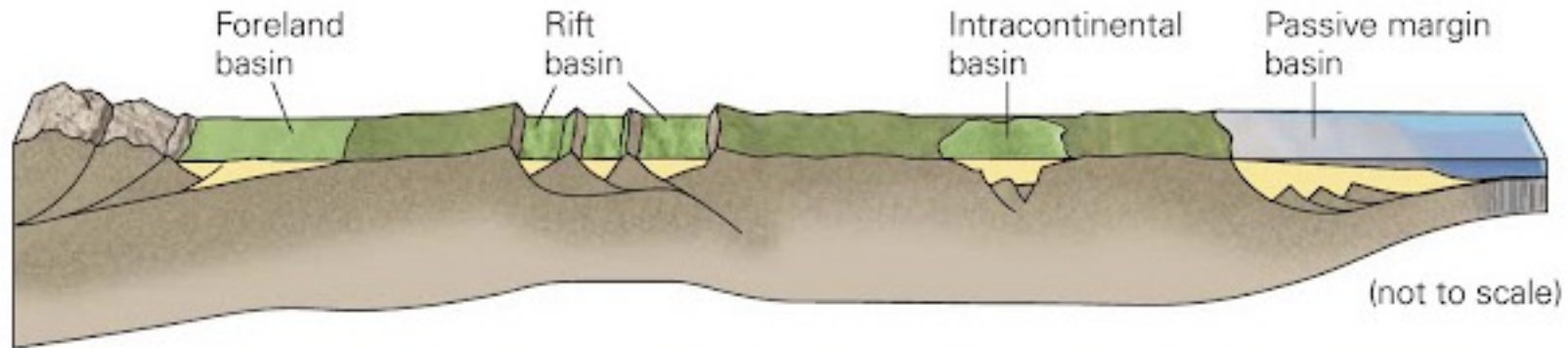
Sedimentary basins



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

Categories of Basins in the Context of Plate Tectonics Theory



Weight of the mountain belt pushes down the crust's surface.

Downward slip on faults produces narrow troughs.

The basin forms in the interior of a continent, perhaps over an old rift.

Subsidence occurs over thinned crust at the edge of an ocean basin.

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](#).

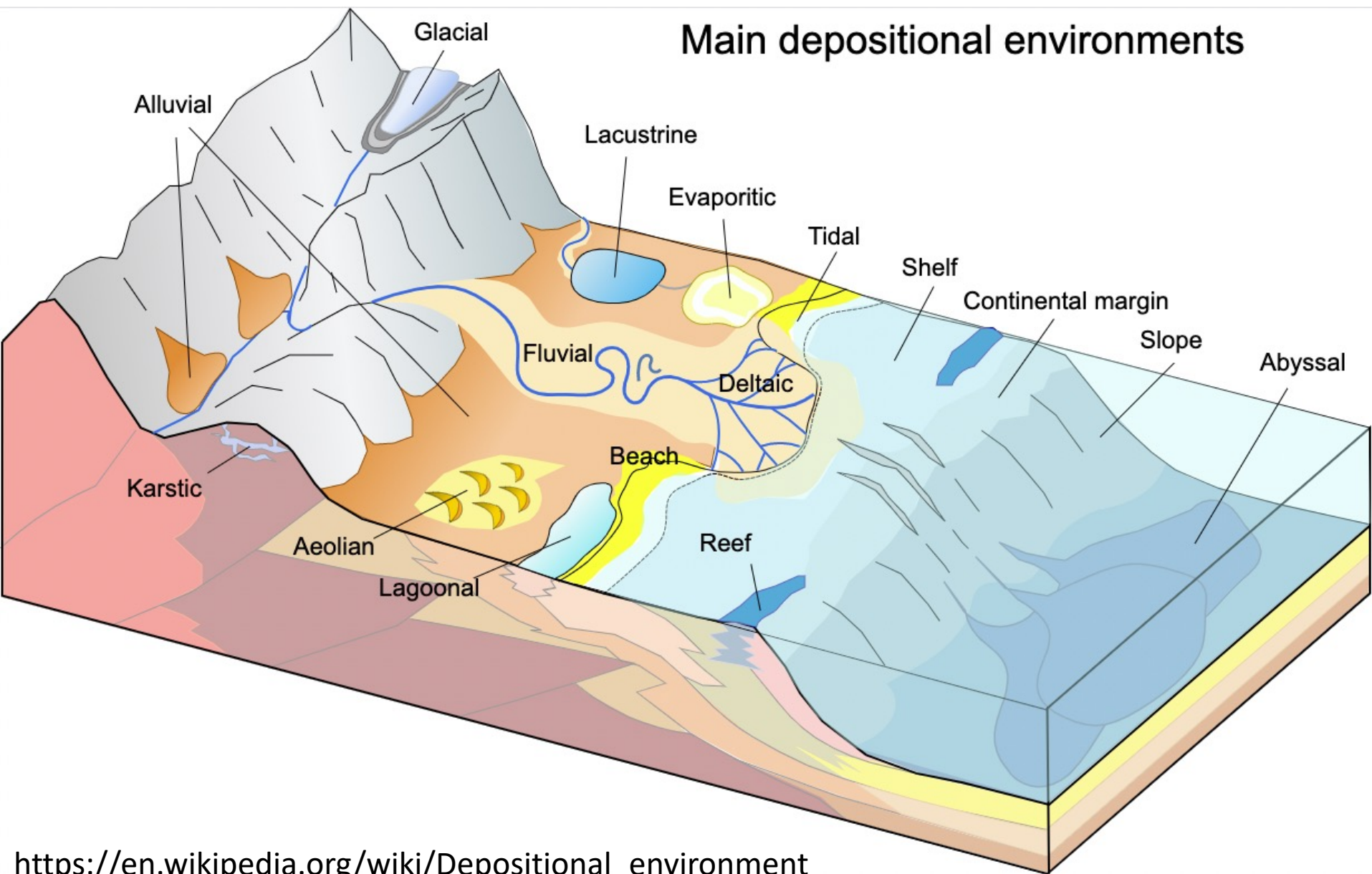
Aspects of the sediment, namely its [composition](#), primary structures, and internal architecture, can be synthesized into a history of the basin fill. Such a synthesis can reveal how the basin formed, how the sediment fill was [transported](#) or precipitated, and reveal sources of the sediment fill.

[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)

Main depositional environments



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

Module	Topic	Teacher	Date
1.1	Introduction to the course	Rebesco	03/10/22
1.2	Methods (geophysics, but not only)	Volpi/Rebesco	06/10/22
6.1	Visit to the icebreaker Laura Bassi (along with Geologia Marina)	Rebesco	10/10/22
1.3	Mechanisms of basin formation (geodynamics, tectonics...)	Lodolo	13/10/22
1.4	Seismic interpretation, facies and primary structures	Rebesco	17/10/22
1.5	Energy storage & CCUS	Volpi/Donda	20/10/22
2.1	Sedimentary processes in river & deltas	Rebesco	24/10/22
	No lessons: 27 th and 31 st October, 3 rd November		
2.2	Action of tides and waves, wind and ice	Rebesco	07/11/22
2.3	Density currents, bottom currents and mass transport	Lucchi/Rebesco	10/11/22
3.1	Alluvial deposits, lakes and deserts	Rebesco	14/11/22
3.2	Barrier systems and incised valleys	Rebesco	17/11/22
3.3	Continental shelves (waves, storms, tsunamis)	Rebesco	21/11/22
3.4	Submarine fans (gravity flows on the continental slope)	Lucchi/Rebesco	24/11/22
3.5	Sediment drifts (bottom currents along the continental slope)	Rebesco	28/11/22
3.6	Mass transport deposits	Ford	01/12/22
3.7	Abyssal plains (hemipelagic fallout) and continental margins	Rebesco	05/12/22
	No lesson on Thursday 8 th December		
3.8	Glacial depositional systems	De Santis	12/12/22
3.9	Carbonatic environments, faults, volcan	Rebesco	15/12/22
4.1	Sequence stratigraphy: introduction	Rebesco	19/12/22
	No lessons from 23 rd December to 8 th January		
4.2	Sequence stratigraphy: closer view	Rebesco	09/01/23
4.3	Sequence stratigraphy: applications (e.g. hydrocarbon reservoirs)	Rebesco	12/01/23
5	Excercis	Rebesco	13/01/23
6.2	Visit to CoreLoggingLAB (along with Geologia Marina)	Rebesco	20/01/23
6.3	Visit to OGS and SEISLAB (along with Geologia Marina)	Rebesco	27/01/23