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C1.- TRAINING COURSE

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DIDACTIC UNIT I:

INTRODUCTION TO GEOLOGY

University of Bucarest / Hateg Country UNESCO Global Geopark

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Specialists and parteners from Geotur Project

Organizația Națiunilor Unite pentru Educație, Știință și Cultură · Geoparcul Internațional UNESCO Țara Hațegului · European Geoparks · Universitatea din București

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SUBJECTS

The aim of the training course

Skills to be developed

Few basic elements in geology

Additional support

- Geotur Manual / Dictionary
- Data base (Cristina Toma)
- Interactive tools / Training

Examples of evaluation tools

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GEOTOURISM

Geoturism Guide-Interpreter

Profession
Employability

Training

New Competence Units

- To interpret the geological heritage and its values to tourists and visitors of European Geoparks.
- To provide accompaniment and assistance services to geotourists and visitors, designing geotouristic itineraries through places of geological interest.

New and enlarged points of view → New employments

New and unique experiences for tourists

- Tourism companies of nature
- Ecoturism and active tourism
- Geological routes organization for travel agencies

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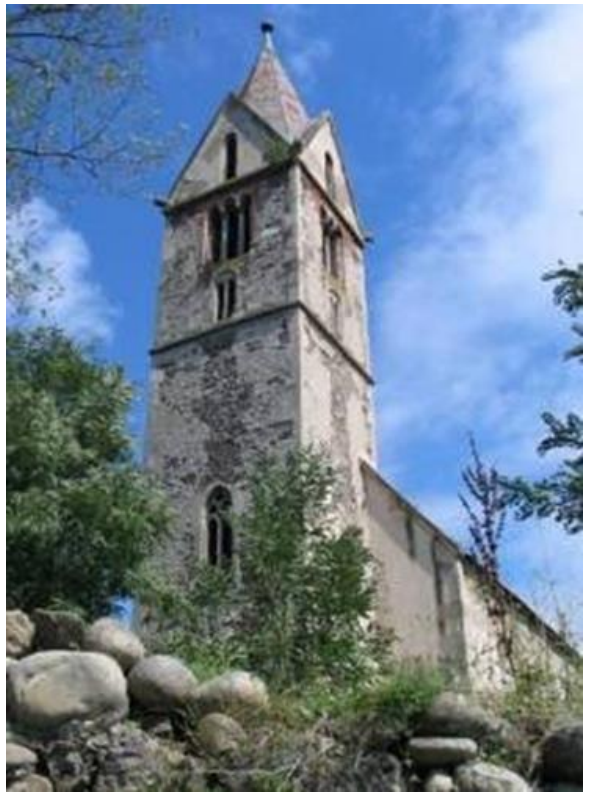
GEOLOGY IS EVERYWHERE!



https://www.usgs.gov/faqs/how-many-pounds-minerals-are-required-average-person-a-year?qt-news_science_products=0#qt-news_science_products

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IN ORDER TO START TO LEARN GEOLOGY, YOU NEED TO SEE GEODIVERSITY

Geodiversity – is the variety of earth materials, forms and processes that constitute and shape the Earth at the global and local level.
Geodiversity components are variable in time as result of former processes or ongoing ones and being continuously transformed including complete removal.

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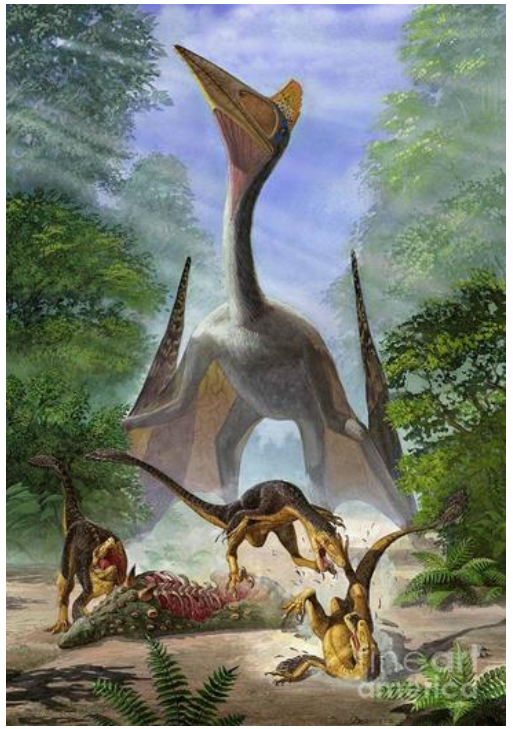
KEY POINT:
OUR HISTORY IS PART OF THE EARTH`S HISTORY - 4,5 BILLION YEARS!

https://www.extremetech.com/extreme/179768-the-moons-real-age-is-finally-revealed-but-the-mystery-of-earths-tardy-development-lives-on

https://web.stanford.edu/group/stanfordbirds/SAN/Exhibit/Darwin.html



https://ro.pinterest.com/pin/625226360767733894/

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GEOTUR APPROACH

LEARNING OBJECTIVES & COMPETENCIES

1. Capacity to understand **THE EARTH COMPONENTS AND PROCESSES**, their **spatial** and **temporal** relations and **dynamic**.

CE 1.1. Capacity to understand and use of **specific terms, concepts, models**;
(MINERALS, ROCKS, RELATIVE AGE OF ROCKS & FOSSILS, PLATE TECTONICS, VOLCANIC ERUPTIONS, EARTHQUAKES)

CE 1.2. Capacity to understand the meaning of **geologic time**
(YEARS, MILLIONS, BILIONS OF YEARS / ARCHEAN / PROTEROZOIC / PALEOZOIC / MEZOZOIC / CENOZOIC)

CE 1.3. To **recognize minerals, rocks, fossils**, body of rocks, processes and patterns generating them;
(MINERALS (TYPES) / ROCKS – MAGMATIC / METAMORPHIC / SEDIMENTARY)

CE 1.4. Mental capacity for **2D and 3D models**, capacity to understand maps and diagrams;
(BODY OF ROCKS / FAULTED AND FOLDED / SURFACE & UNDERGROUND)

CE 1.5. Capacity to analyze the quality of **observational data** supporting earth science concepts;

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Earth is a small rocky planet part of the Solar System / Milky Way Galaxy / Laniakea Supercluster / Univers

https://www.cntraveler.com/gallery/the-best-nasa-images-of-earth-from-space

https://www.techtimes.com/articles/248157/20200318/nasa-detects-two-asteroids-coming-towards-earth-could-this-pose-a-threat-bigger-than-the-coronavirus.htm

Earth 4,5 Ga
(artistic reconstruction)

https://www.livescience.com/64970-early-earth-spin-magma-ocean.html

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Rocky planet

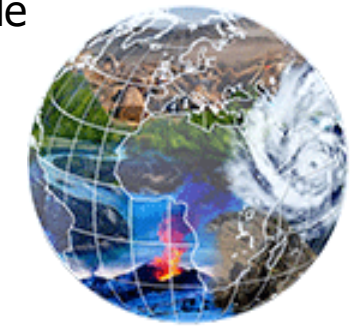
Liquid water

Planet's energy → External, Internal

External → Life's evolution; Climate balance; Water cycle; Erosion processes

Internal → Plate tectonics → Carbon-silicate cycle

The only life foster planet



The **Earth** is a very active planet, subject of continuous changes controlled by **geological processes**.

Internal geological processes

Heat stored in the Earth's & Radioactive decay

Movement of the lithospheric plates

- Earthquakes
- Volcanic eruptions
- Opening of new seas and closed old ones
- Formation of mountain ranges

External geological processes

Solar incoming radiation

Cosmic radiation

Biological activity

→ Climate
Erosion and weathering

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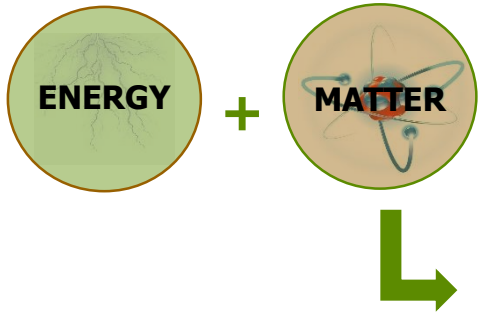
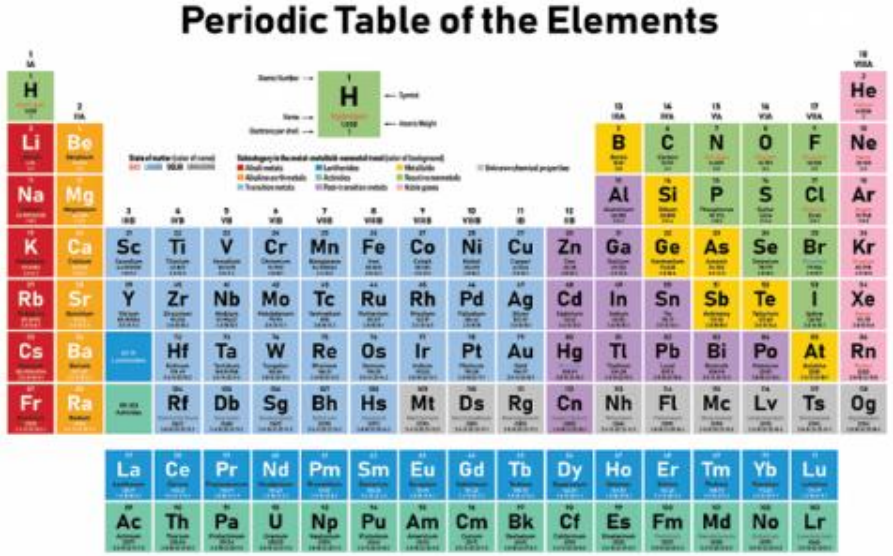
EARTH MATERIALS



92 natural elements

Were forged in cosmic process and recycled in new stars



The most abundant on Earth's crust: Oxygen Silicon Aluminium Iron Sodium Magnesium Potassium Calcium

Minerals

Crystalline structure compounds made of one or more chemical elements which are represented by a specific formula

Silicon + Oxigen → Quarzt

→ **Mohs hardness scale**

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Rocks

- One mineral
- Several minerals
- Fragments of other rocks

Classified by their **genesis**

IGNEOUS ROCKS

- Molten magma's solidification
  - Inside the crust
  - Over the surface
- Intrusive rocks
- Extrusive rocks

Granite, basalt, andesite, ryolite, dacite

SEDIMENTARY ROCKS

- Layers from clastic, chemical and biochemical sediments

Weathering, erosion, organisms' activity and gravitational sedimentation

Conglomerates, sandstone, loess, mudstone, limestone, salt, **gypsum**, chert and coal

METAMORFIC ROCKS

- Pressure and temperature change
  - Type of minerals
  - Organization's way

Tectonic process

Phyllite and schist (foliated)
Quartzite and **marble** (non-foliated)

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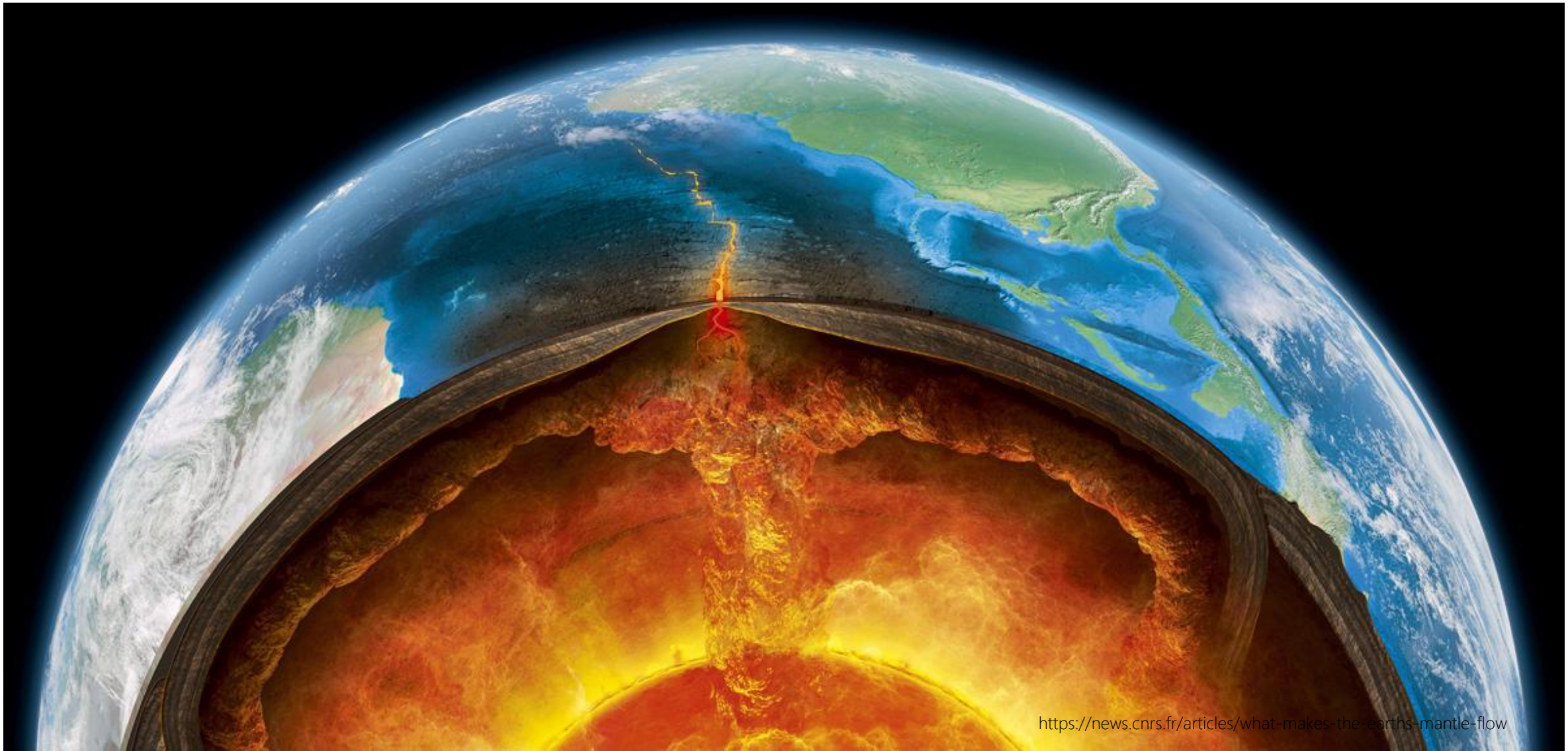
Earth`s interior and plate tectonic



https://news.cnrs.fr/articles/what-makes-the-earths-mantle-flow

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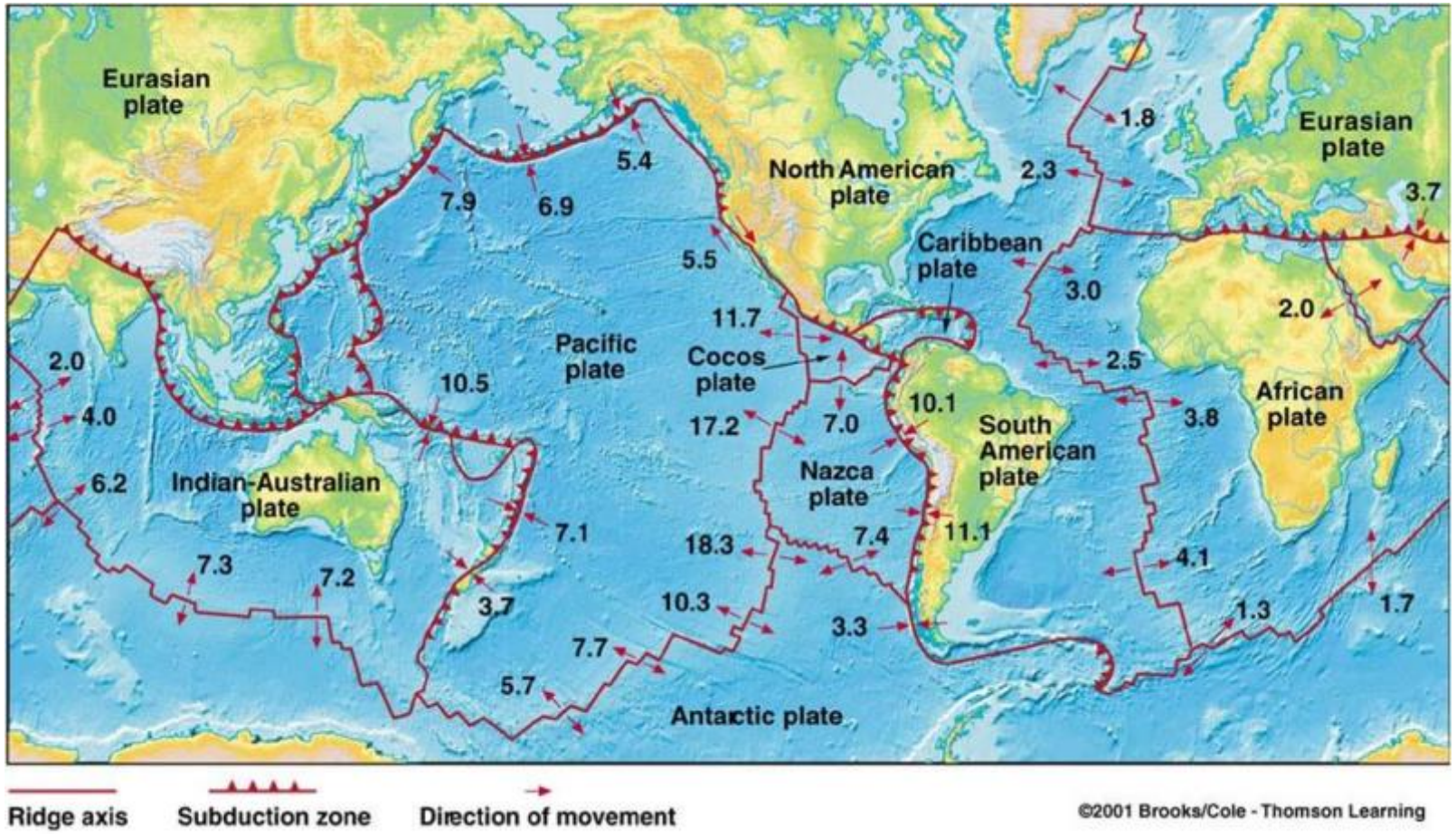
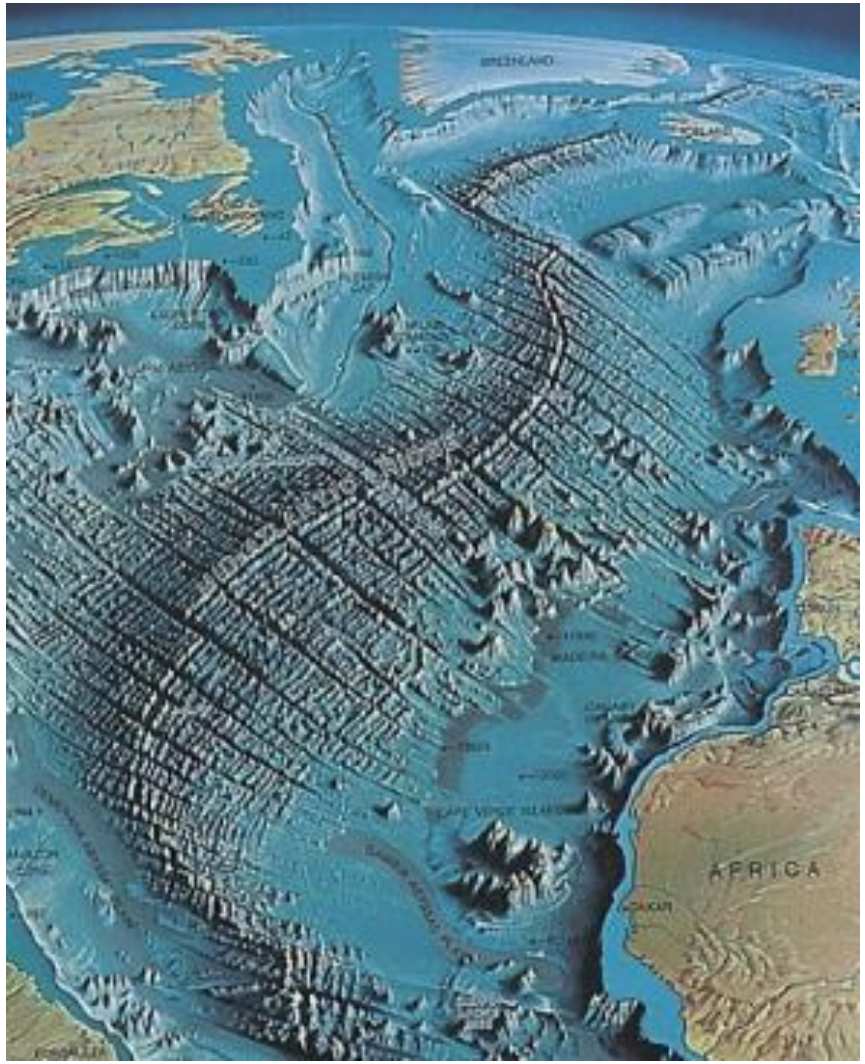
Lithospheric plates and their movement (cm/year)



https://www.quora.com/Which-continental-plate-is-moving-the-fastest-and-why

Mid-Atlantic ridge



Sursa: http://www.physicalgeography.net/fundamentals/10h.html

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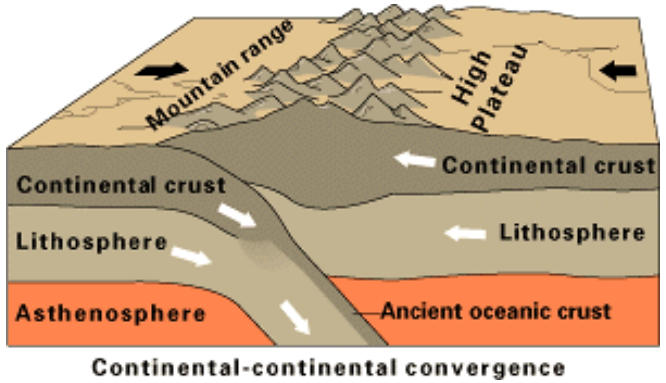
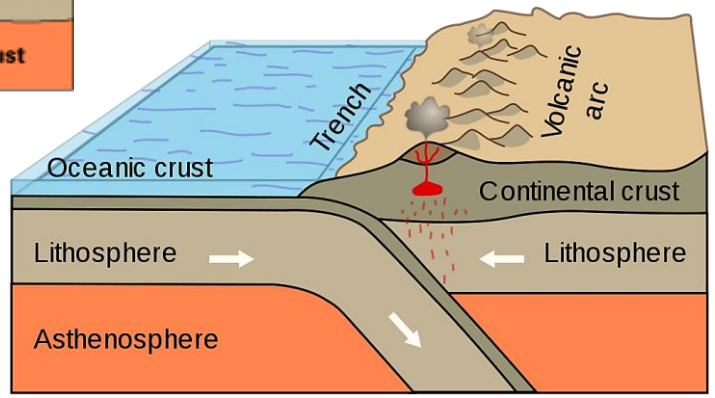
CONTINOUS MOVEMENT OF PLATES GENERATES ROCK DEFORMATION

OROGENS / MOUNTAINS

An **orogen** is a major elongated and geologic structure forming orogenic belts or mountain ranges, which were formed due to accretion or collision and comprise all the compressed and deformed rocks.



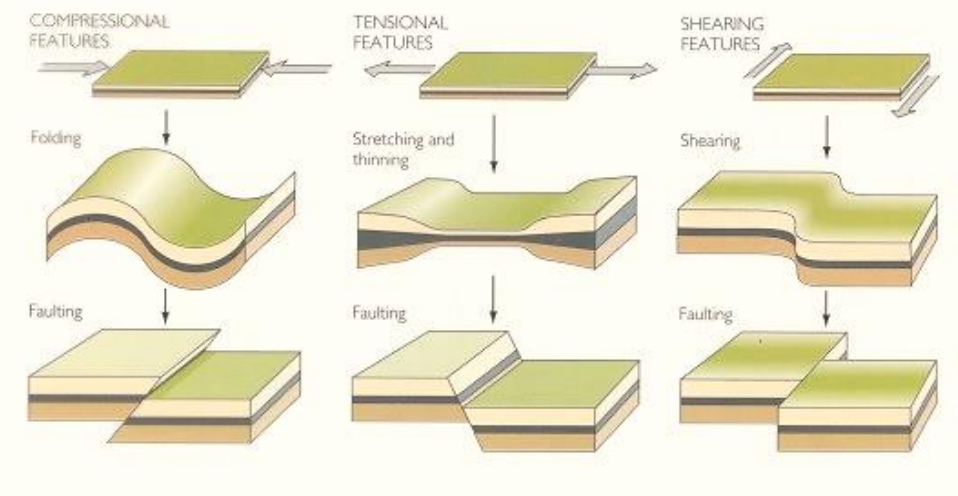


Orogens' formation

MODIFICACTION OF ROCKS - FOLDIG AND FRACTURIG

Plate movements generate enormous tectonic compression, extension and shearing forces able to transform and **deform rocks** and **create folds and faults** with sedimentary rocks, as well as igneous and metamorphic ones.

Types of stresses available



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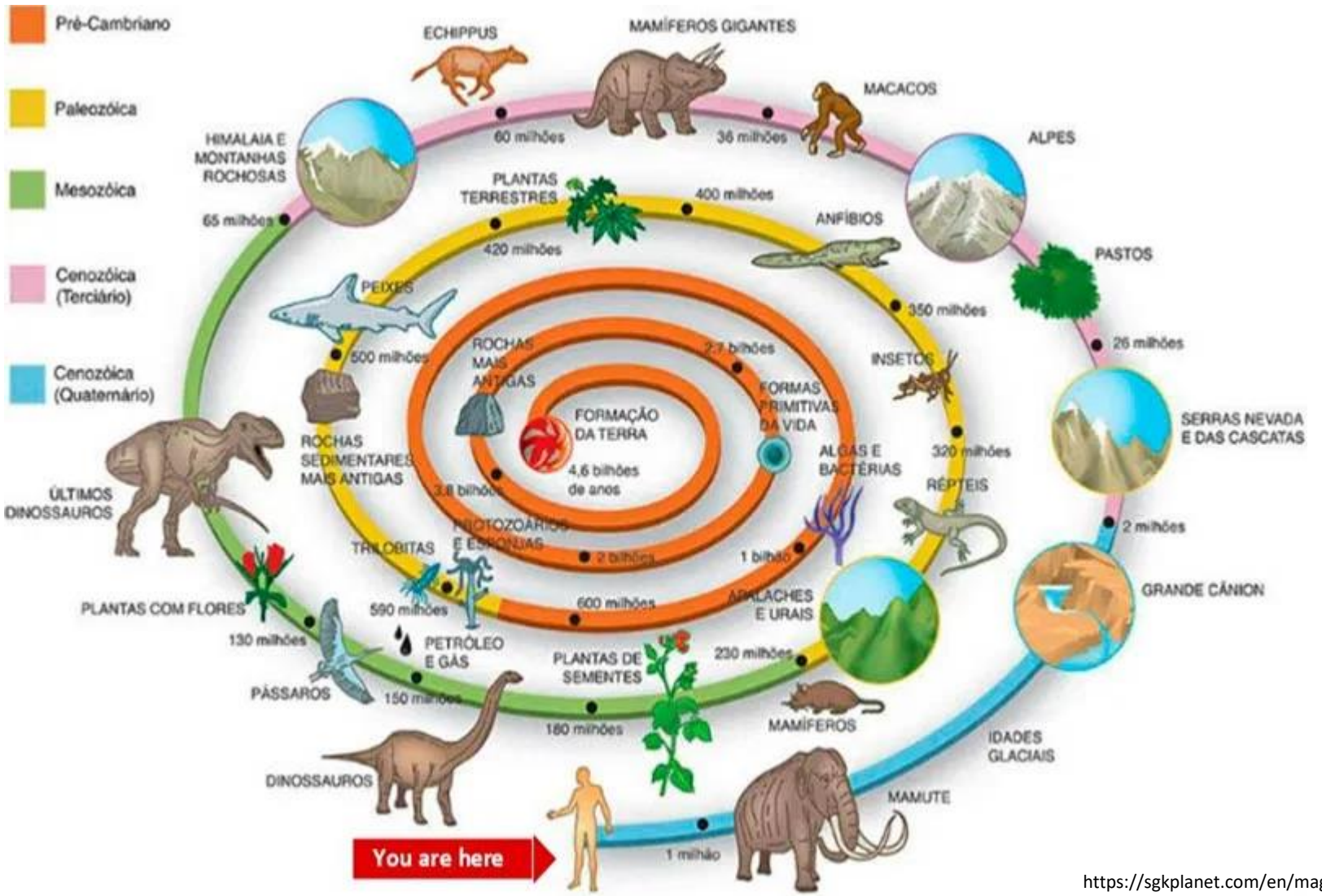

https://sgkplanet.com/en/magazine-all-about-anthropocene/

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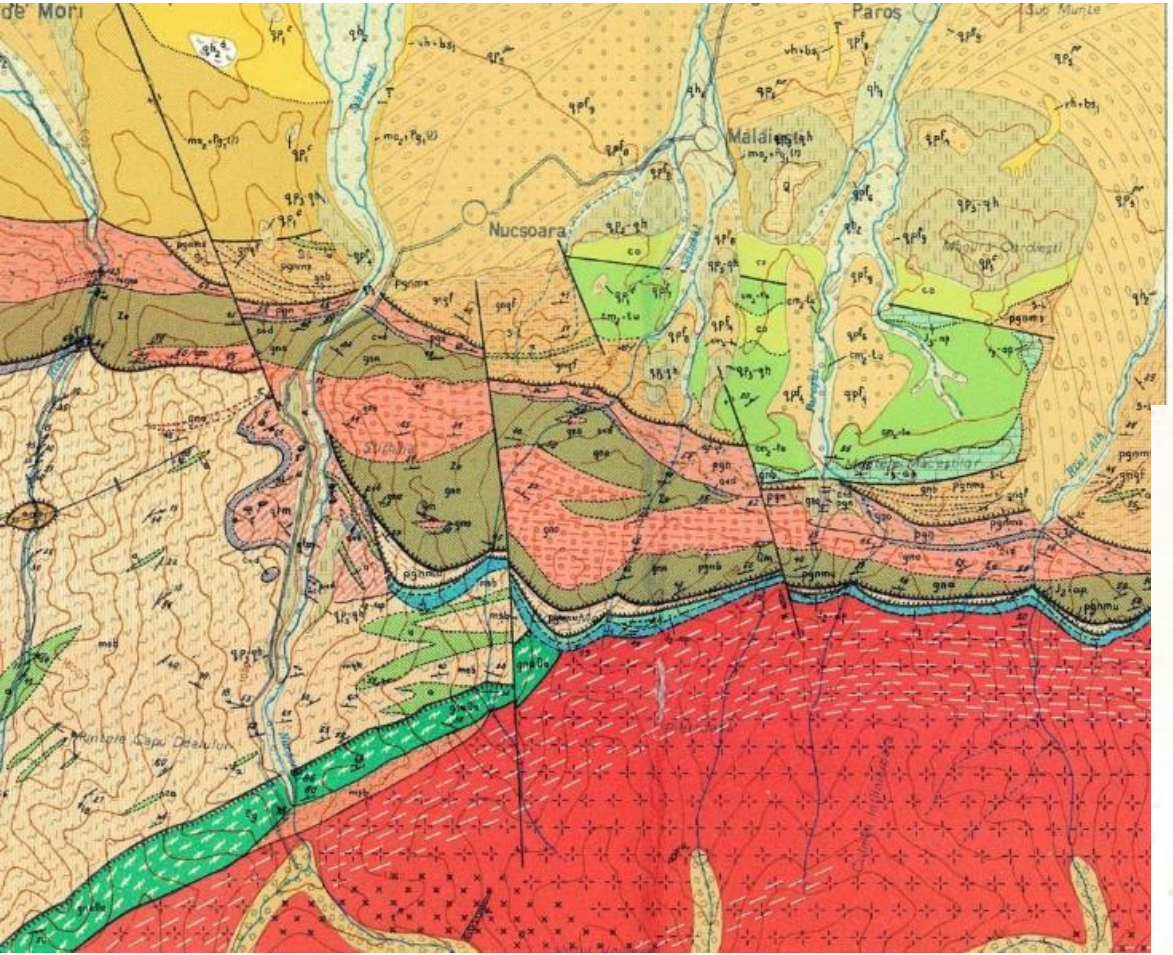
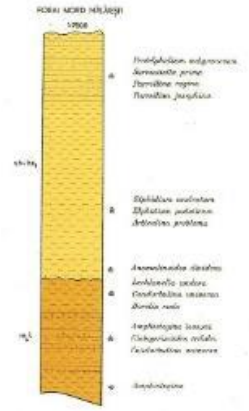
How to recognise geologic bodies in the field?

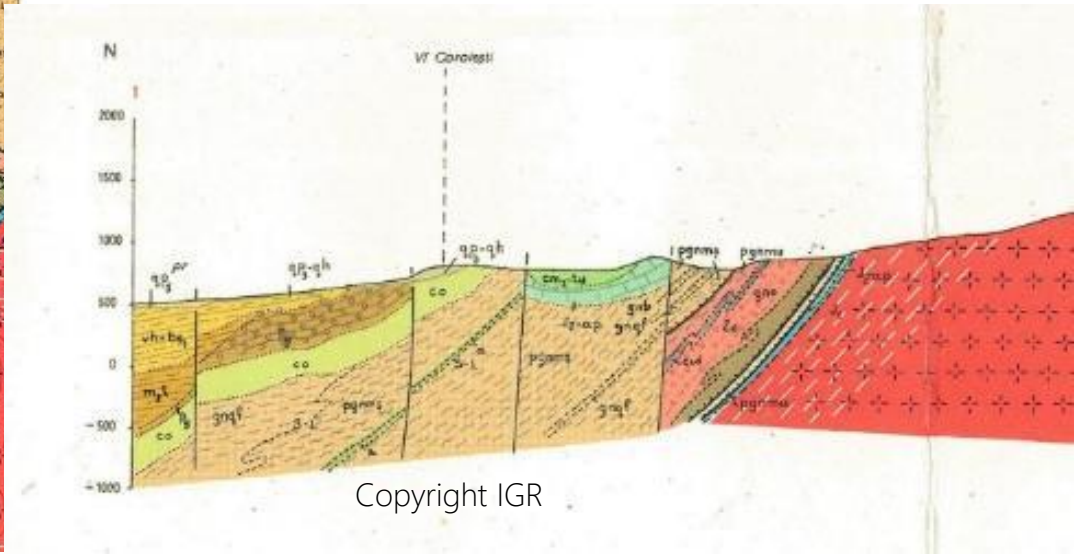
Geologic map – 2D representation of the surface body of rocks (lithology) and coloured according to their type and age (Hateg Geopark UGGp – Geologic map 1:50.000)

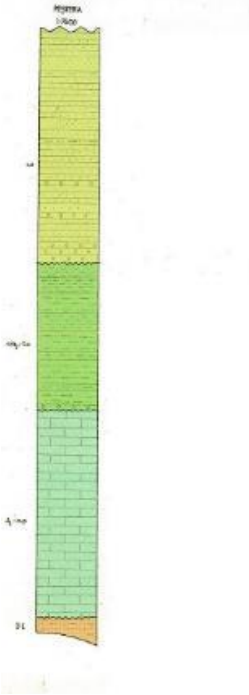


Stratigraphic column
2 D representation of the rocks bodies according to their age



Geologic section
2D representation of a vertical cut in the crust





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2. Acquire knowledge about the origin and geologic evolution of Europe

CE 2.1. Capacity to identify the main geological and structural characteristics of Europe;

CE 2.2. Capacity to understand and describe the key events that led to present geological structure of Europe;

EAST EUROPEAN PLATFORM / OROGENS / CALEDONIAN / VARISCAN / ALPINE

CE 2.3. Capacity to understand the role mineral resources (Europe geodiversity) have played in economic and social development of Europe.

RAW MATERIALS / SALT / CUPPER / IRON / GOLD / OIL

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Geological structure of Europe

The European continent, whose history began about 3.500 million years ago, is part of the Eurasian Plate.

Two major areas:

- The East European Craton → Archean/Lower Proterozoic basement
- Western, central and southern Europe → Assembled during different orogenic cycles

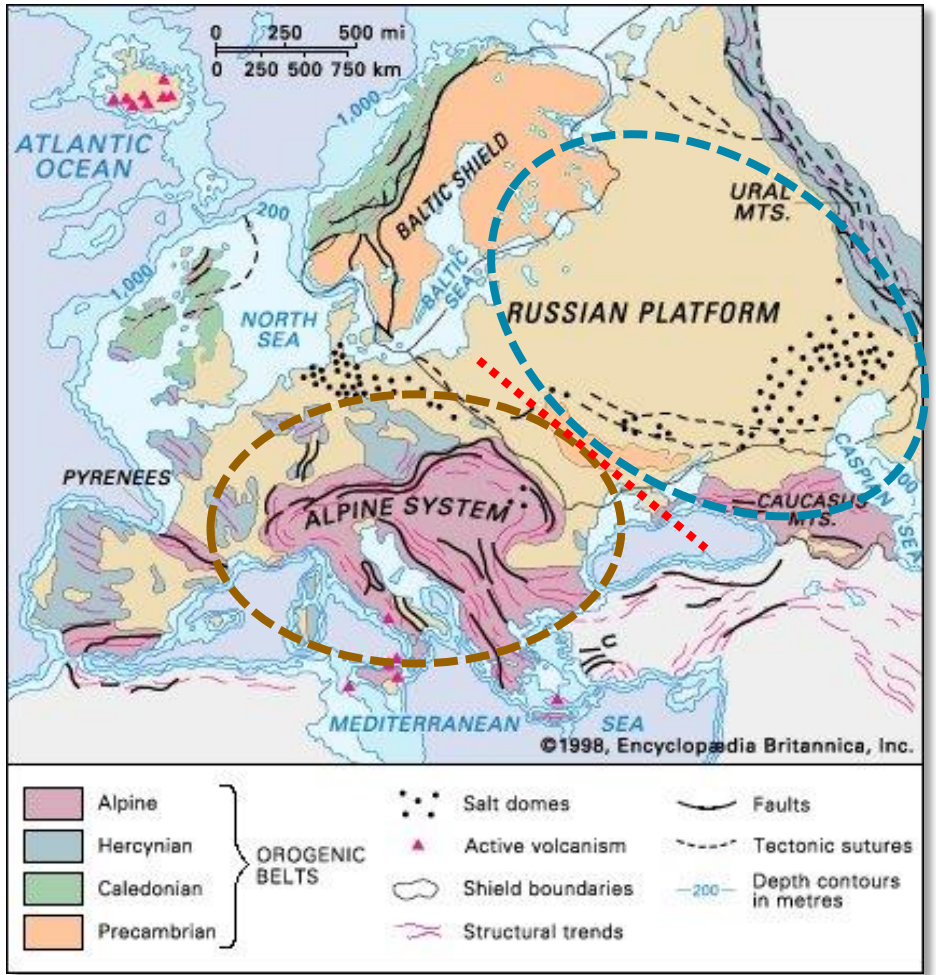
The tectonic units of Europe include :

- East European Craton
  Remants of Laurentia Craton
- The Caledonian belt
- The Variscan-Scythian belt
- The Alpine belt
- The Mediterranean Region

American plate

Eurasian plate

African plate



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3. Capacity to understand the landform and landscape of Europe and their spatial and temporal connections and dynamic

CE 3.1. Capacity to identify and analyze geomorphological processes and forms;

CE.3.2. Capacity to search, identify and relate geological structures and landforms;

CE. 3.3. Acquire specific techniques to recognize and describe weathering processes, denudation and depositional materials and different types of landscapes;

CE. 3.4. Capacity to understand the Europe evolution after Ice Age;

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Geologic structures and landforms in Europe

Landforms are surface shapes we are measuring and mapping, which could have <u>different geological contexts</u>:

Landforms could be regarded at <u>different scales</u>:

Large landforms → Ocean ridges, volcanic arc, rivers
Small landforms → Hills, ravens, lakes and valleys

Plate collision and accretion
Grabens and horst due to faults
Volcanic eruptions
Denudation

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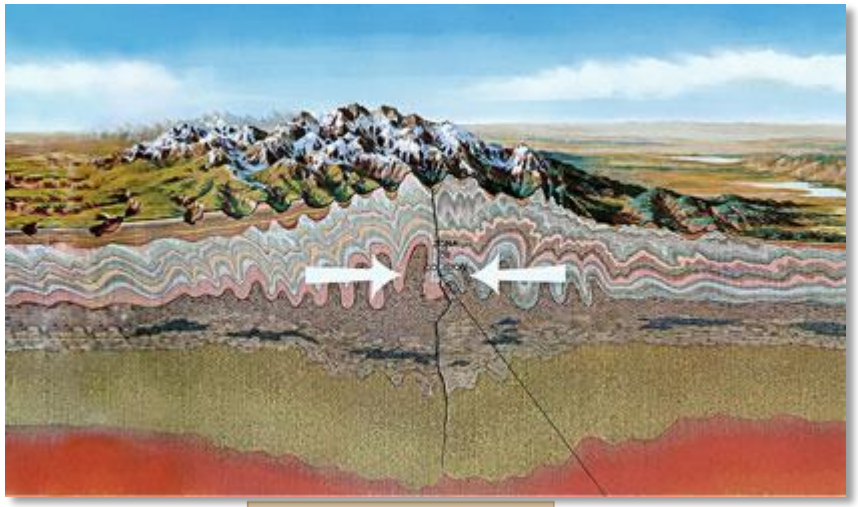
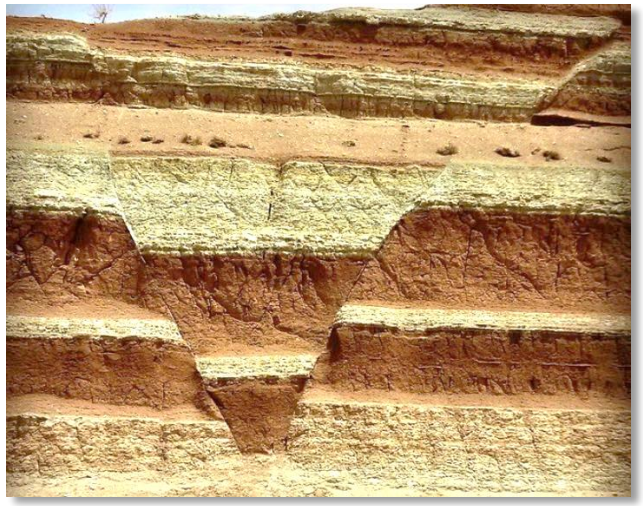
Shaping the Earth surface

Plate collision



Volcanic eruption

Tectonic / Graben and horst



Denudation

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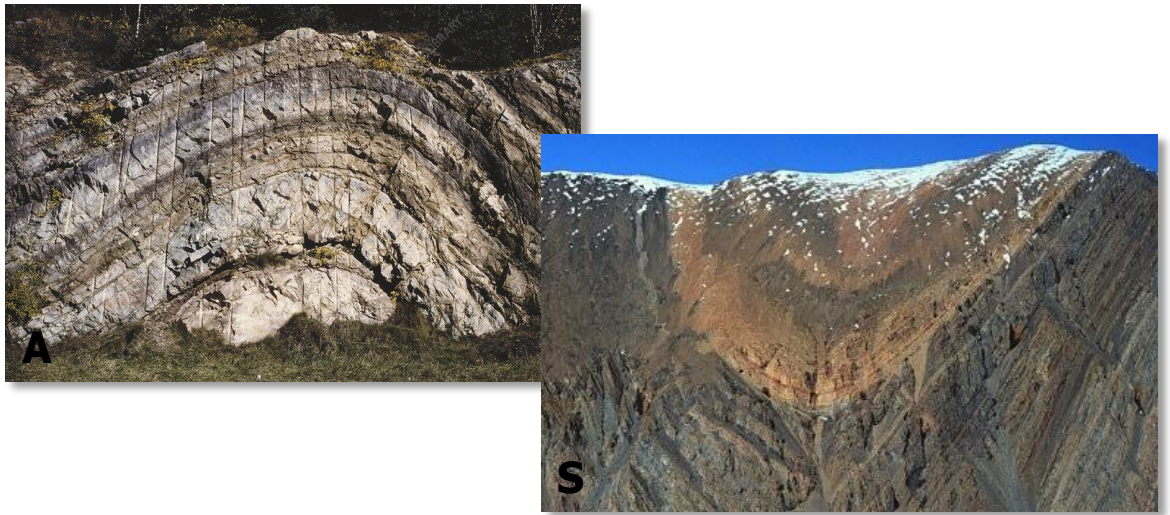
Crater lake

Pyroclastic flow

Folded rocks

Anticline and syncline folds



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Denudation and deposistion

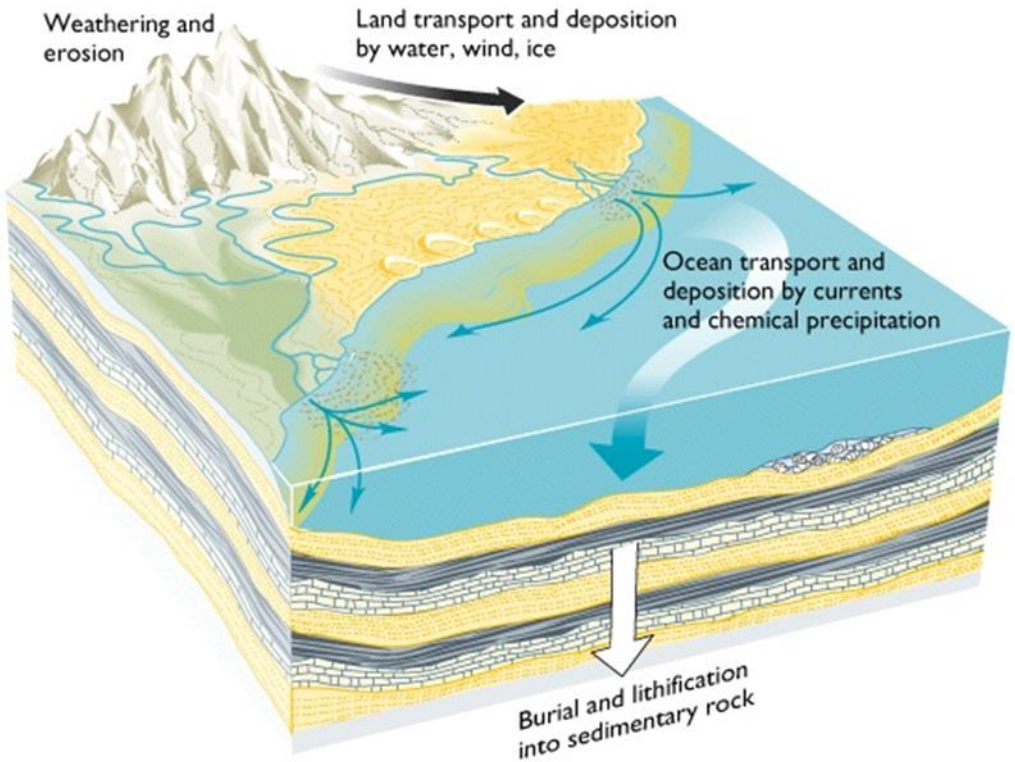
Denudation and **deposition** are controlled by gravitational forces and by the agent of transportation.

DENUDATION → Weathering and erosion

- Water and its forms
- Gravity
- Wind

DEPOSITION

- Sedimentary particles' accumulation in the lowest potential energy position
- Gravity
  Water (Rivers, Ice, Oceanic currents)
  Wind



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Denudation and deposition

Hill-slope

Fluvial landforms

Glacial landforms

Eolian landforms

Coastal landforms

Karst landforms

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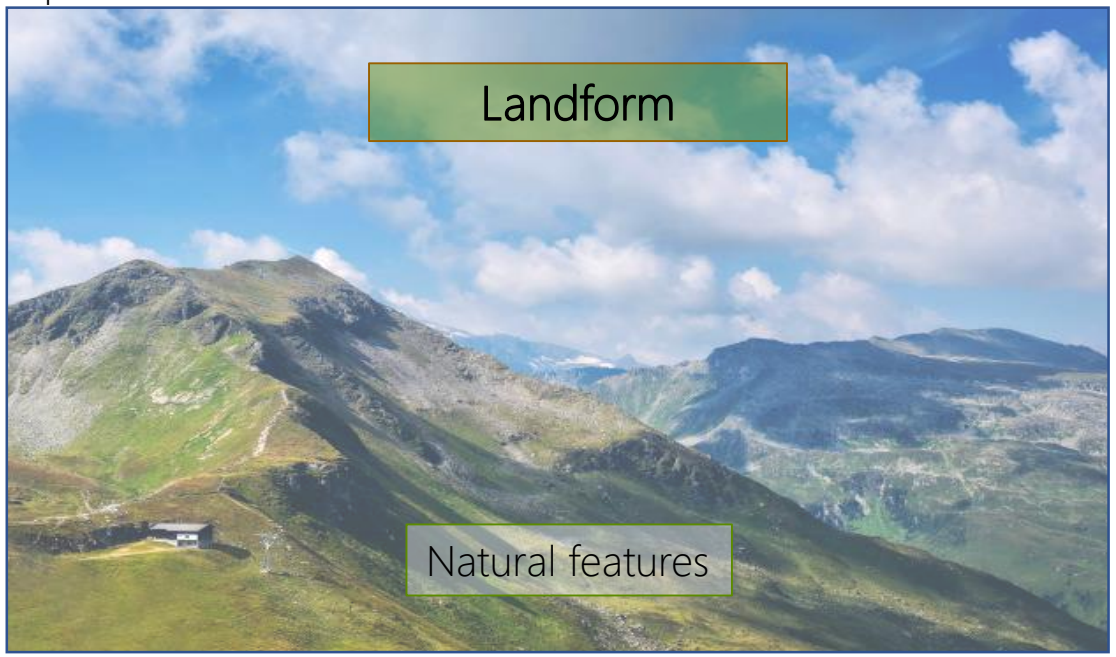
Landscape and Landform

The **Earth's surface** is very diverse and is made up of elements shaped by **internal** and **external natural processes**. During the last millennia human activities started to influence more and more the surface natural environment. The results of all these activities have generated what we call **landform** and **landscape**.

Related to human activities and the way these activities transformed the natural forms.

Characterized by the features of a landscape and their natural origin: tectonic and structural elements, erosion, rocks, and geologic phenomena like volcanoes, gravitational slides, or depositional environments.



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4. Acquire knowledge to understand the intrinsic link between Earth and human civilization

CE. 4.1. Capacity to understand geology as part of human culture;
(UNDERSTANDING THE EARTH / EARTH`S AGE)

CE. 4.2. Acquire specific knowledge and techniques to recognize and present the intangible heritage of different stone made objects;
(STONE MADE OBJECTS HAVE MULTIPLE STORIES)

CE. 4.2. Capacity to understand and present the reasons specific geologic materials, events, phenomena, products are classified as geologic heritage.
(GEOLOGICAL HERITAGE AS PART OF OUR CULTURE)

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Geology and culture in Europe

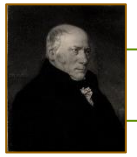
Geology as science is part of the human culture. All great geological discoveries could be considered as milestones in evolution of our modern society leaving traces in economy, biology, geography, social life, astronomy, history, philosophy, literature and art.

The key moments and persons are part of a common **cultural intangible heritage** and could be regarded also as sources of inspiration and understanding how science is working.

JAMES HUTTON

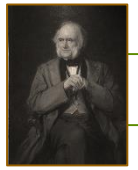
The father of Geology

The Man who Found Time



WILLIAM SMITH

Connection between rocks and fossils



CHARLES LYELL

The process that occurs today are the same ones that occurred in the past

GEORGES CUVIER

The father of Paleontology

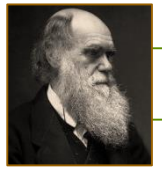
WILLIAM BUCKLAND

Fossil dinosaur: Megalosaurus

MARY ANNING

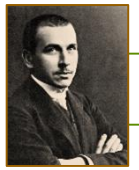
Paleontological findings

First Plesiosaurus skeleton



CHARLES DARWIN

The Origin of Species



ALFRED WEGENER

Continetal Drift hypothesis

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Geology and human life
The dialogue between Man and Earth

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EVALUATION

Additional support

Geotur Manual / Dictionary / Interactive tools / Training

Evaluation tools of developed skills

Quizzes /
Identify a rock type
Read a geologic map
Use of the Geologic time scale
Identify connexions betyween geology and local culture (stone made objects / intangible heritage
Tell a geological story to a tourist

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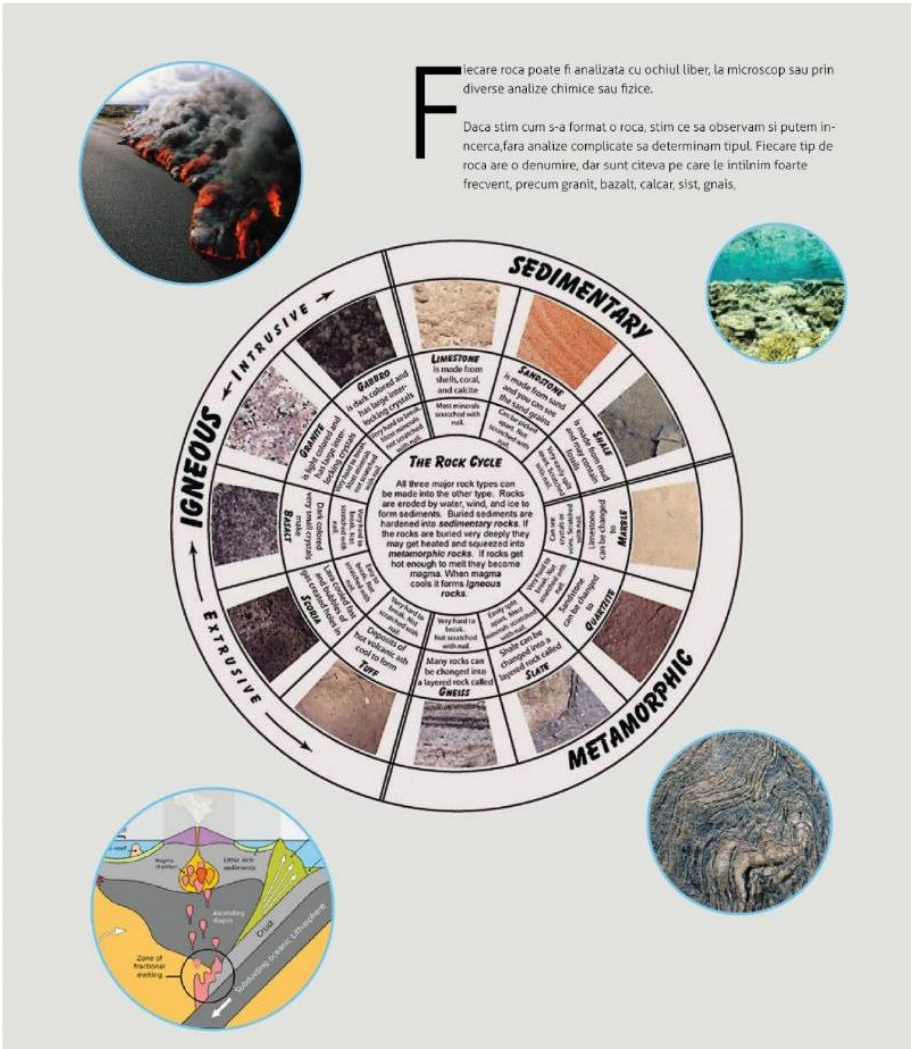
How to recognise a rock?

Igneous rocks



Sedimentary rocks

Metamorphic rocks

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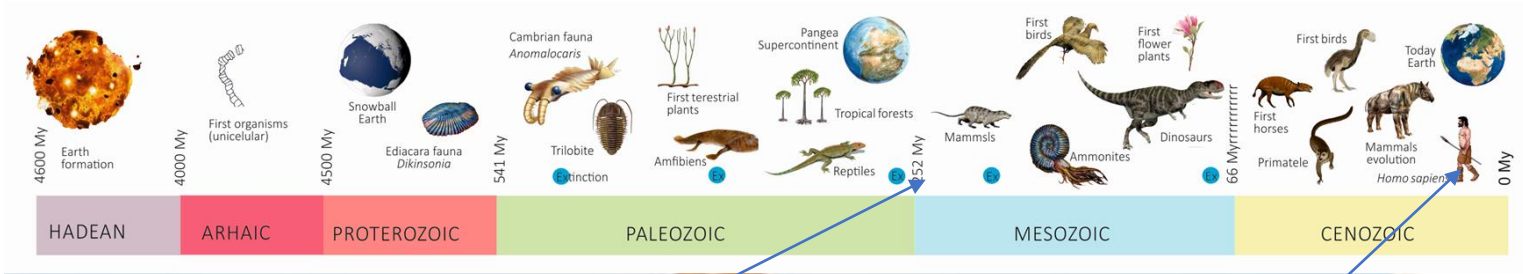
What`s wrong in this picture?



https://www.wired.co.uk/article/paleocolour-dinosaur-facts

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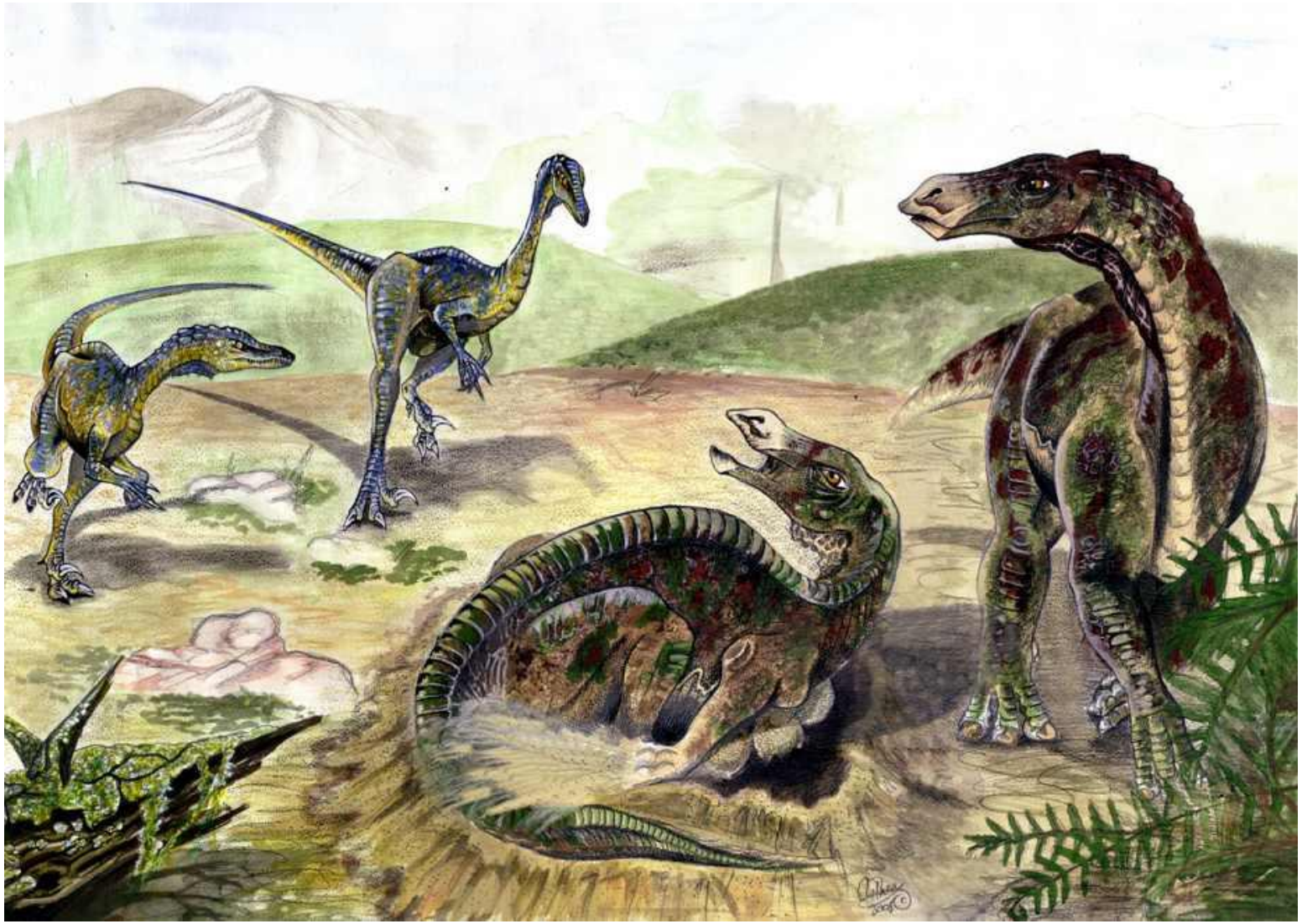
What about Hateg dinosaurs?



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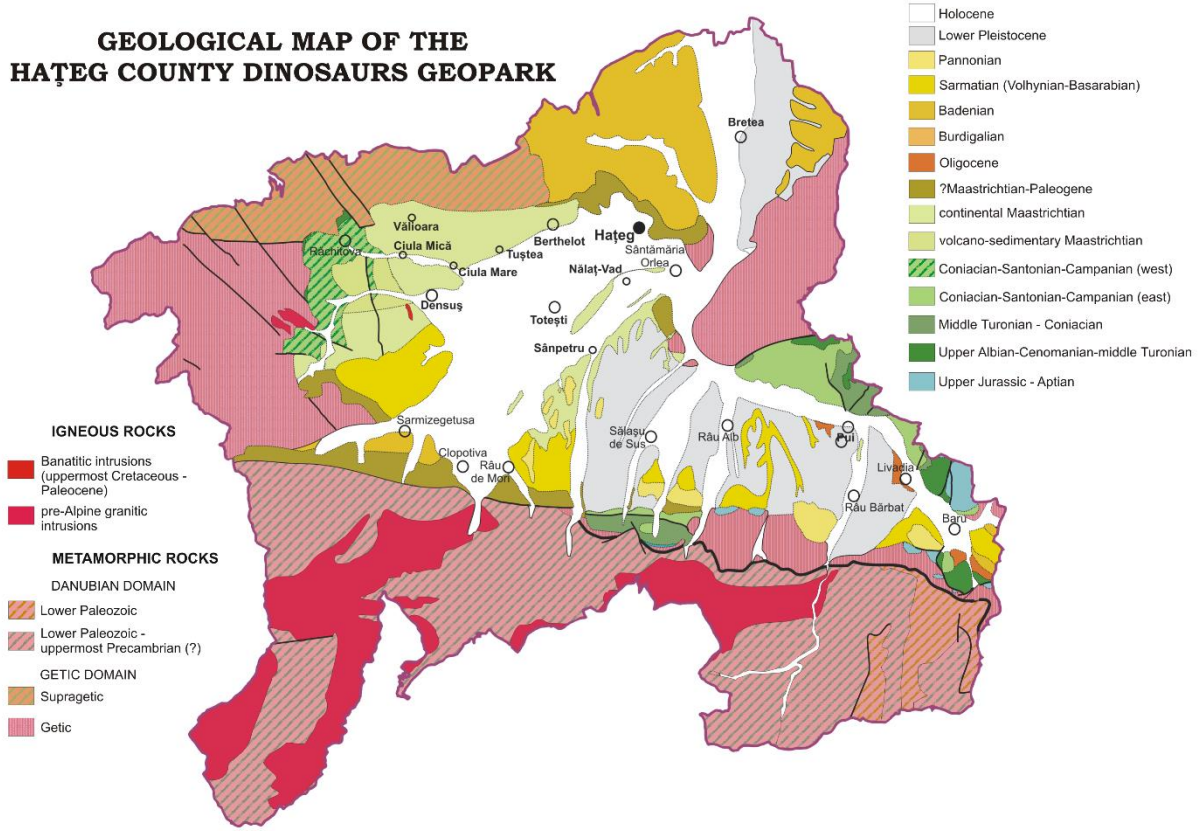
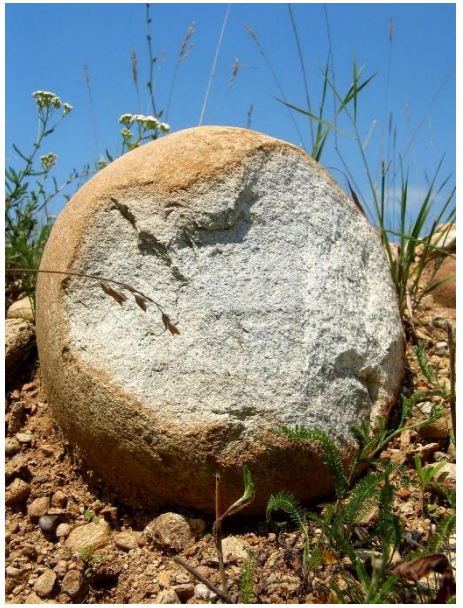
Where different rock types are coming from ?





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How to tell a geological story to a tourist

RGHP (Haute Provence UGGp)

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Thank you and good luck!

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