Summing-up

Stratigraphy and Tectonics in the study of Earth Sciences

- The rocks on the surface of the Earth exhibit complex geometric relationships between each other, which, for numerous applications, it is necessary to understand and investigate.
- **Stratigraphy** provides the tools to trace the original geometrical orientation of the layers of rocks and the order in which they were formed.
- **Tectonics**, however, is the study of deformations affecting the rocks after their formation, as a result of movements in the Earth's crust.

Elements of Stratigraphy

- The object of study in stratigraphy is geological formation. A **geological formation** is a rocky body, of a generally uniform nature, that originated in an environment that was stable over a long period of time.
- A **strata** or layer is the smallest unit of sedimentary rock formation: it is, in general, of modest thickness but large expanse.
- A **facies** indicates the set of a rock's lithological characteristics and depends on the formation environment. In determining the facies of a rock, it is possible to trace back to the environment in which it was formed.
- Amongst sedimentary facies there are common **continental** facies (glacial, fluvial, desert etc.), **transition** facies (marsh, estuary, coastal, etc.), and **marine** facies (coastal, neritic, pelagic, etc.).
- Stratigraphy has developed some principles for establishing, based on field observations, the relative chronology according to which different rocky structures were formed:
  - The **principle of original horizontality**;
  - The **principle of (stratigraphic) superposition**;
  - The **principle of intersection**.
- The study of successive facies over time sheds light on the phenomena of **regression**, the withdrawal of water from previously flooded areas, and **ingression** (or **transgression**), the advance of the sea on continental areas.
- Transgression gives rise to an unconformity which may be:
  - **simple**, if the strata or layers prior to the transgression and successive ones are all parallel;
  - **angular**, if the layers prior to the transgression form an angle with successive ones.
- For an unconformity, which describes a geometric aspect, there is a corresponding **sedimentation gap**. The presence, in a series of rocks, of an unconformity with a sedimentation gap indicates that the following events occurred in succession in the area:
  - deformation and uplift of the crust resulting in the emergence of a new land mass (*regression*);
  - erosion of the new land mass;
  - return of the sea with resumption of sedimentation (*transgression*).

Elements of Tectonics

- Rock bodies appear more or less deformed (translated and/or changed in form). Deformations are successive to their formation and are due to the forces acting within the Earth's crust.
- **Faults** are lacerations of the crust along which rocks bodies slide against adjacent ones. Different types of faults exist:
  - **Normal faults**, which result in an enlargement of the crust;
  - **Reverse faults**, which on the contrary, lead to a shortening of the crust.
- A set of normal faults may cause a local collapse of the crust, called **tectonic rift**, in which the areas of crust that remain elevated are called **horst**.
- The term **fold** implies that an original planar structure, such as a sedimentary bed, has been bent, without breaking (anticlines, synclines).
- If a block of crust, sliding along a reverse fault with a low-angle dip of the fault plane, so that the overlying block is pushed mainly horizontally over a neighbouring sector of the crust, it creates an overthrust sheet.

The Geological cycle

- The **stratigraphic sequence** of an area describes the vertical sequence of the formations involved. The reading and interpretation of stratigraphic series reveals any cyclical repetition of events.
- The **Geological cycle** (or **Hutton cycle**) typically includes:
  - **rock formation**, usually on the bottom of the sea;
  - **tectonic deformation** of these rocks due to movements of the crust, with the development of magmatism and metamorphism and with the lifting up of mountain ranges;
  - the **demolition and erosion** of structures produced by tectonic deformation, up to and including surface smoothing.
- Also, in the same area, a new geological cycle can develop, beginning with a marine transgression and the formation of new sedimentary rocks, unconformally on the older ones. Over billions of years the traces of numerous similar cycles have been left in the rocks of the Earth's crust.

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Geological maps

- Geological maps are a means of recording information about the distribution and structure of the rocks that make up the Earth's surface.
- In the legend of the map the meanings of the colours and symbols are provided. Along with these, the stratigraphic column, a drawing that represents the stratigraphic series, i.e. the vertical succession of rock formations, is also provided.
- Geological sections, which often appear in a frame on the geological map, portray the crust as vertical cross-sections in order to represent the structure of the rocks in depth.

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