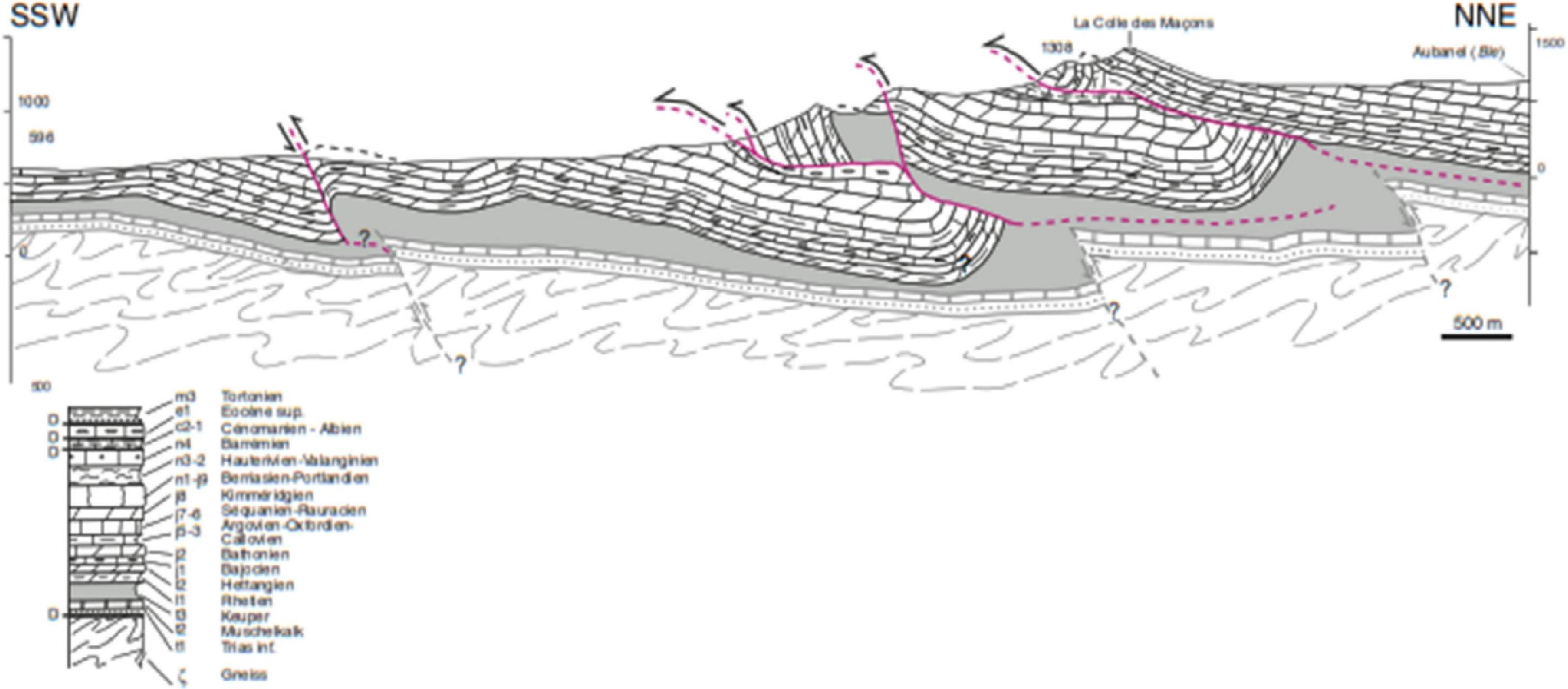
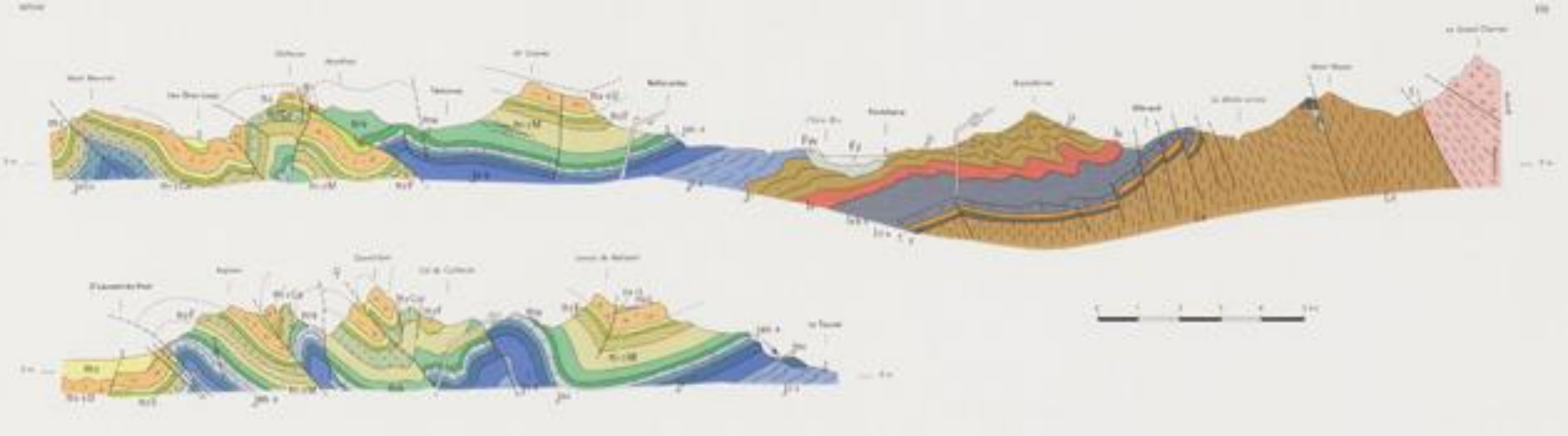
The geological cross-section

The geological cross-section represents the section of terrains by a vertical plane. Geologists are interested not only in the arrangement of surface terrains but also in their extension beneath the surface. The construction of geological cross-sections is a technique that, unlike a topographic profile, requires a certain level of interpretation (as it represents hidden terrains in depth, with only the visible parts being known).

Examples of geological cross-sections can be observed in nature, such as:
- Roadside exposures
- Railroad cuttings
- Quarries
- Deep and vertical gorges of rivers (wadis)
- Marine cliffs, etc.


SSW
NNE
La Colle des Maçons
1308
Aubanel (Bie)
1500
1000
596
0
500 m
500
m3 Tortonien
e1 Eocène sup.
c2-1 Cénomanien - Albien
n4 Barrémien
n3-2 Hauterivien-Valanginien
n1-j9 Berriasien-Portlandien
j8 Kimméridgien
j7-6 Séquanien-Rauracien
j5-3 Argovien-Oxfordien-Callovien
j2 Bathonien
j1 Bajocien
l2 Hettangien
l1 Rhetien
t3 Keuper
t2 Muschelkalk
t1 Trias inf.
ζ Gneiss



1. Steps in Creating a Geological Cross-Section:

The creation of a geological cross-section involves several steps, from selecting the location to designing the legend.

1.1. Selection of Location and Orientation on the Map:

There is no general rule for choosing the location of a geological cross-section, but here are some recommendations:

- It is preferable to choose an area rich in geological information, such as geological contours and dip indicators.
- Avoid areas with extensive coverage of recent superficial terrains.
- In a monoclinic structure, the cross-section should be oriented perpendicular to the general dip direction of the layers.
- In a folded structure, the direction of the cross-section should be perpendicular to the axis of the folds.
- In a tabular structure where the layers are nearly horizontal, the choice of the cross-section orientation is more flexible.

1.2. Notes on Document Layout:

The geological cross-section is typically drawn on graph paper. Here are some notes regarding the presentation of geological cross-sections, applicable to various geological structure constructions.

- Center your drawing appropriately.
- Indicate your name, first name, and group on the top left part of the paper.
- Mention the date of the cross-section creation on the top right part of the paper.
- Place the title in uppercase at the center top of the paper.
- Provide a reminder of the scale for horizontal distances (map scale) and vertical distances (altitudes).
- Indicate the orientation of the cross-section on the two vertical axes delineating the cuts, toponymy, and hydrography.
- Construct a proper legend on the right side of the cross-section, and if more space is needed, you can use the left part of the drawing. The legend must include squares or rectangles made with a ruler representing the layers, their age, and a brief description of the lithological nature of the layers.

1.3. Creating the Topographic Profile:

The topographic profile should be carefully created by selecting the appropriate orientation. Indicate valley bottoms (v), ridge lines (^), and the elevation of surveyed points along the edge of the graph paper.

1.4. Layer Projection:

The projection of layers onto the topographic profile involves first identifying all layers outcropping along the cross-section line (using colors and notation). Start by drawing the most recent layer, for which both the roof and the floor are known wherever it outcrops.

Once this initial layer is drawn, continue with the underlying layers, respecting the thickness and boundaries of each layer. Alluvial deposits left by rivers during floods do not play a role in the geological structure; represent them at the end with a thicker pencil line on the profile.

Finally, place the symbols accurately and with great care.

Nom:

Prénom:

Groupe:

Date:--/--/20--

échelle

unité

Altitude

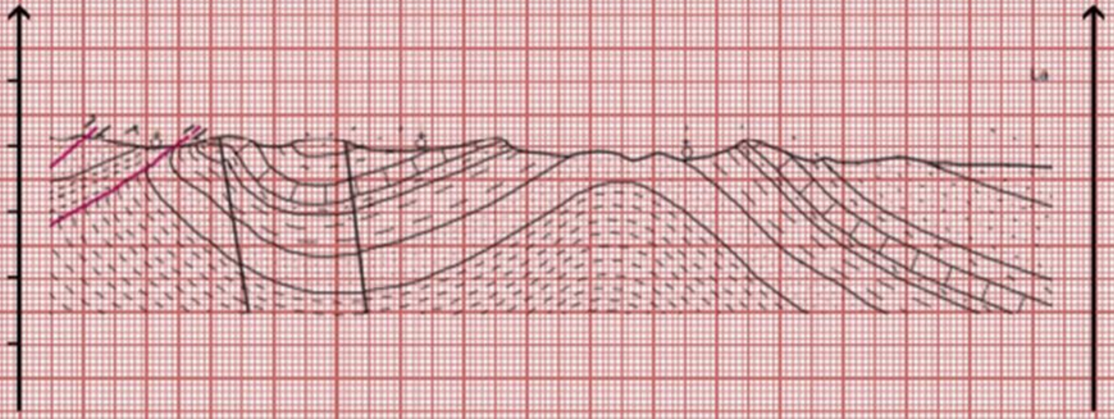
unité

Distance horizontale

Titre; (en magiscule)

Légende

Orientation



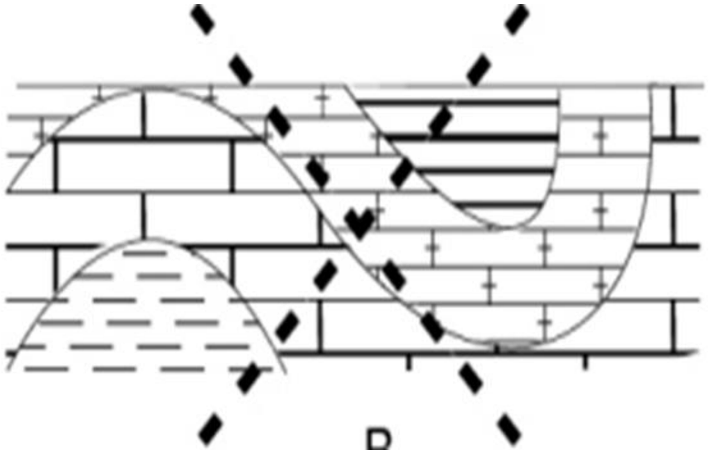
Orientation

Légende

Representation of Symbols:

- While on the map, different terrains are distinguished by notation and color, on the cross-section, we use symbols.
- Symbols should reflect the lithological characteristics of the represented formations.
- The symbols are drawn in relation to the boundaries of the layers and not with the horizontal; in other words, the lines of the symbols will be parallel or perpendicular to the boundaries of the layers.

A



B

Fig.20 (a) : Les signes conventionnelles

Roches Sédimentaires (1) (Anglais)

Source: https://ngmdb.usgs.gov/fgdc_gds/geolsymstd/download.php

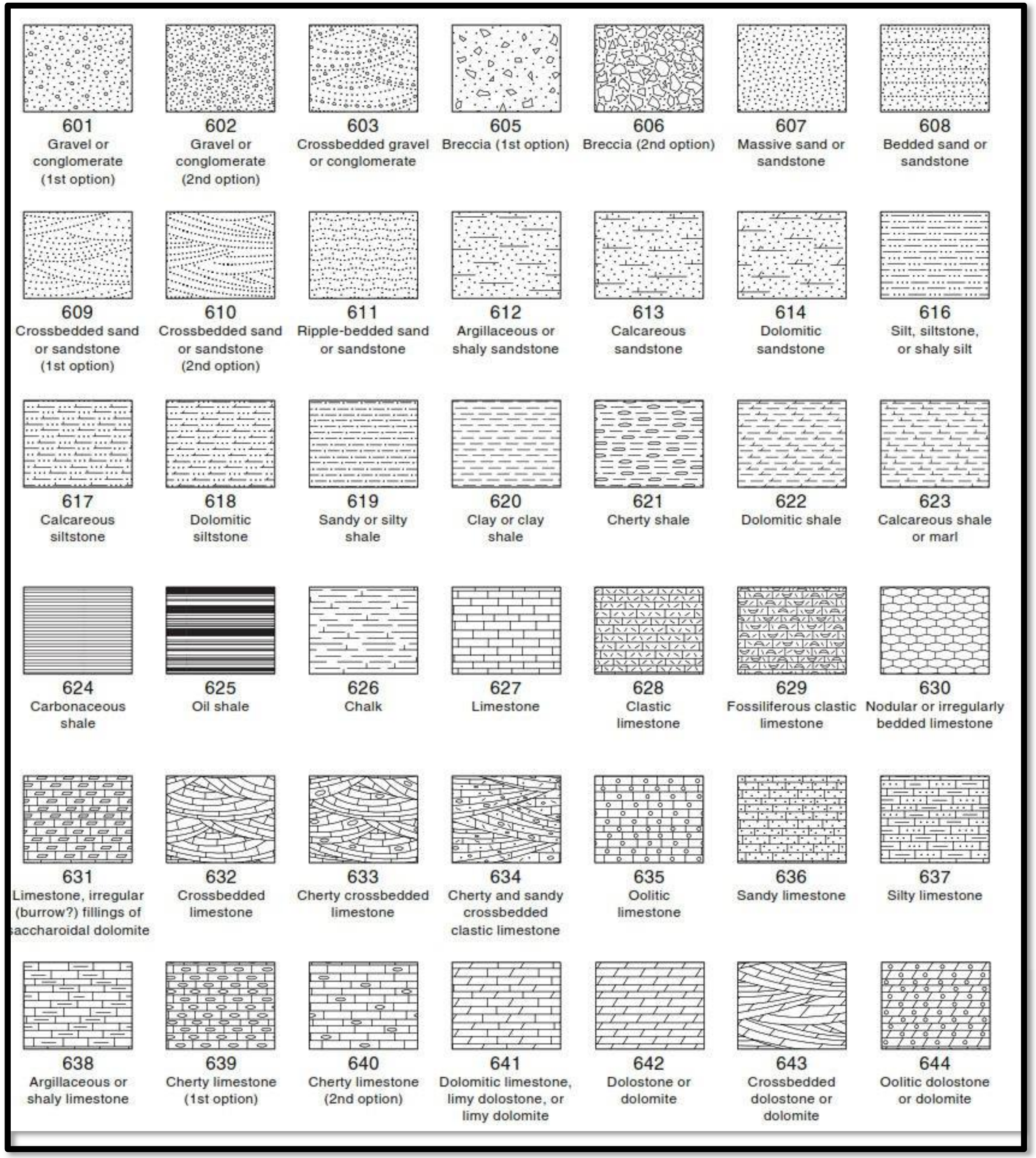
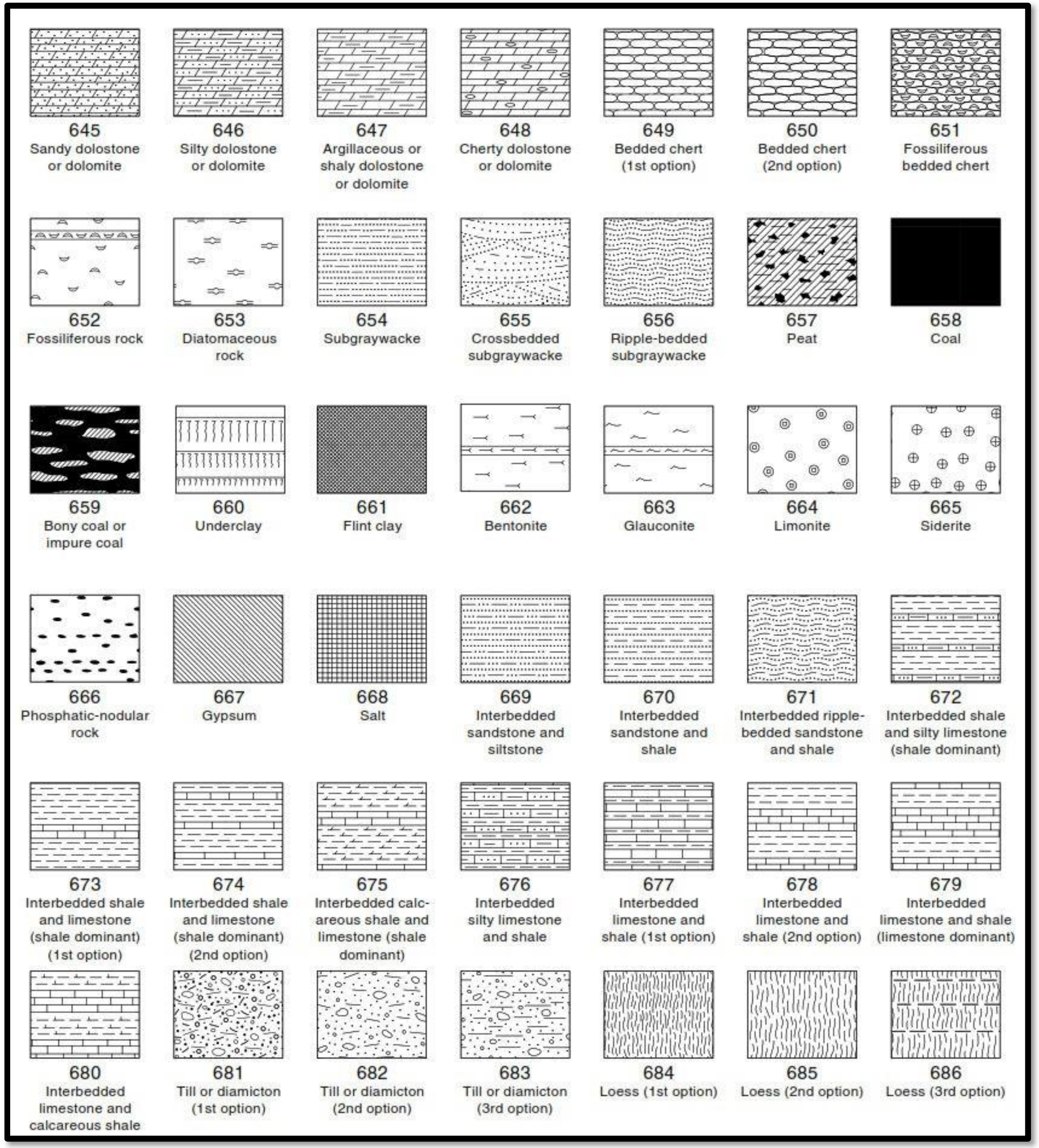


fIG.**20 (b) : Les signes conventionnelles**

Roches Sédimentaires (2) (Anglais)

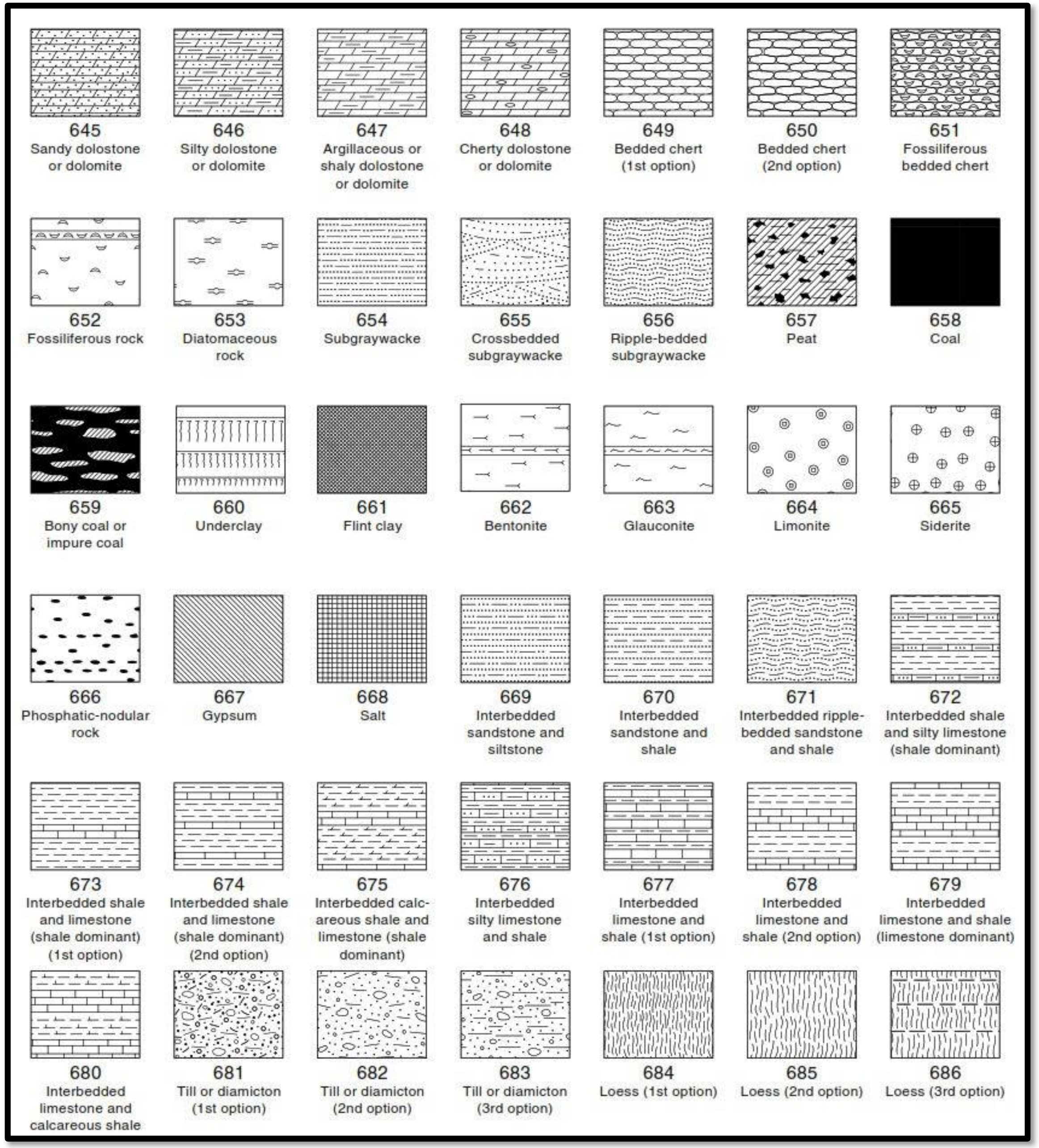
Source: https://ngmdb.usgs.gov/fgdc_gds/geolsymstd/download.php



g.20 (c) : Les signes conventionnelles

Roches magmatiques et métamorphiques (Anglais)

Source: https://ngmdb.usgs.gov/fgdc_gds/geolsymstd/download.php



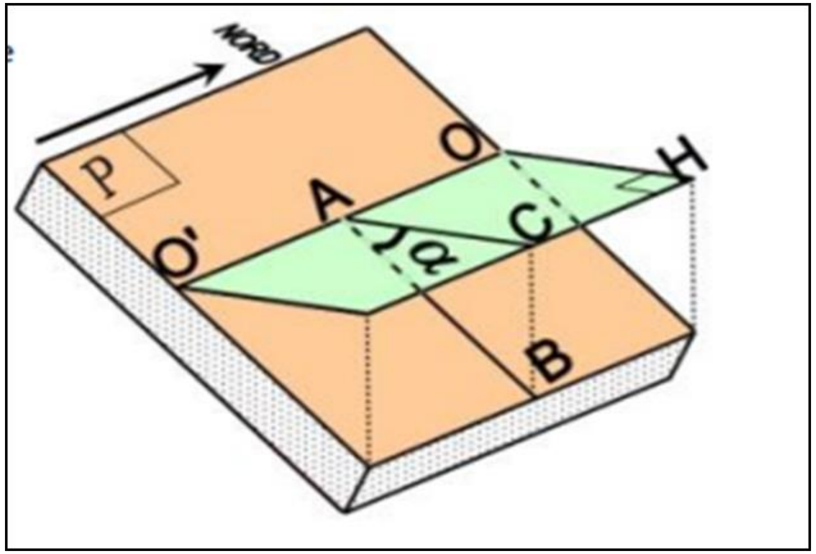
Geometric properties of geological layers:
Strike and dip of a layer:
Layers, whose thickness can most often be considered constant, can be horizontal, inclined, or vertical.

- The direction: When a layer is inclined or vertical, its direction is defined as its intersection with a horizontal plane (OO' in the figure). The direction of a plane is measured in the field with a compass, that is, relative to magnetic north, and is then plotted on the map relative to geographic north.

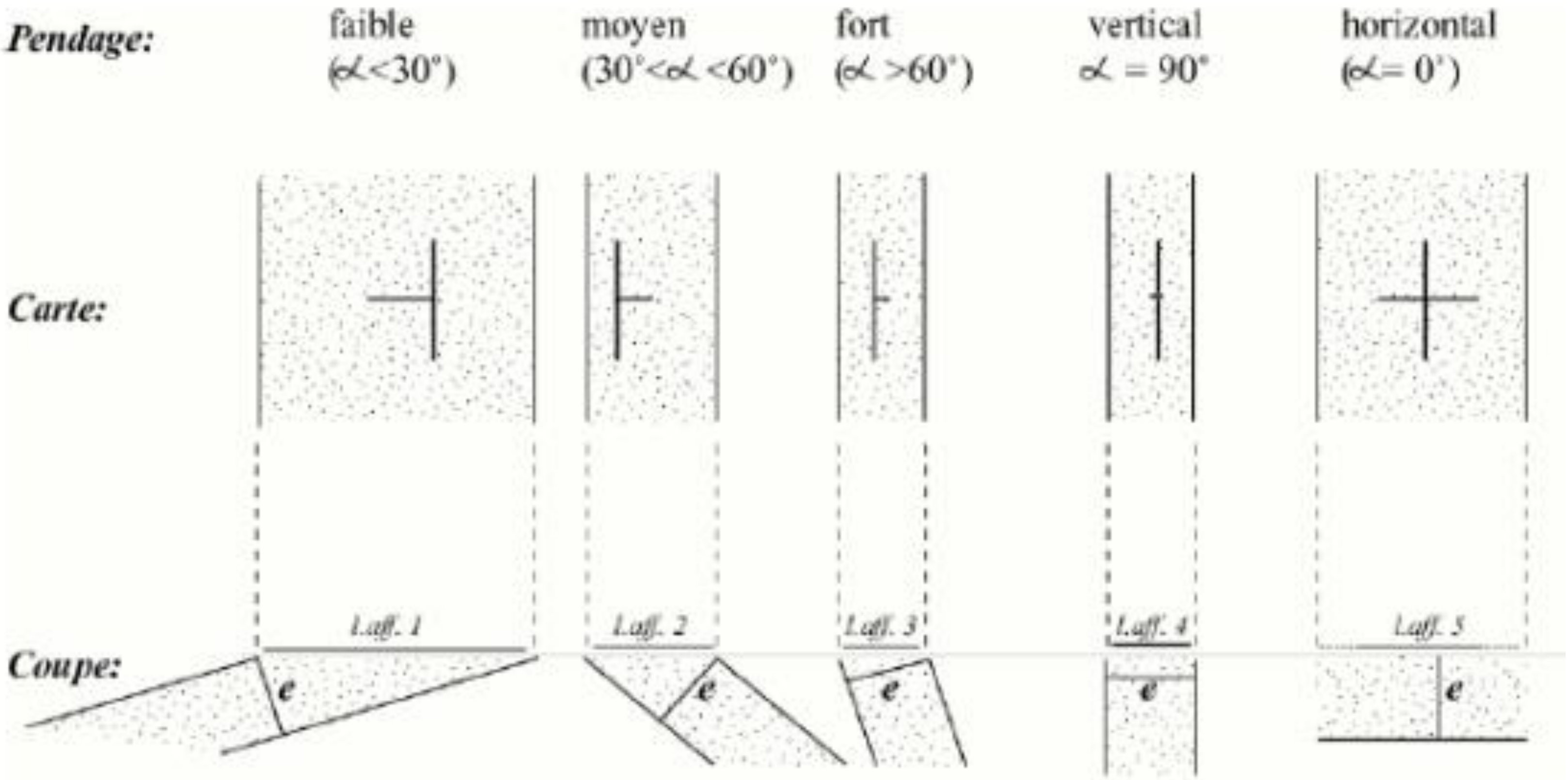
- The dip, or inclination, of this layer at a given point is the dihedral angle it makes with a horizontal plane. The dip angle is equal to the angle (α) formed by the steepest line AB with its projection AC onto a horizontal plane. The value of (α) ranges from 0° to 90°, being high when the dip is steep and low when the dip is gentle.

The dip direction is defined by the line AC oriented towards the side where the layer inclines downwards (AC ⊥ OO’).

OO’: layer direction
H: horizontal plane
AB: line of greatest slope
AC: projection of AB onto H perpendicular to OO’,
this segment indicates the dip direction
α: dip angle value



On geological maps, the dip of layers is indicated by a T-shaped symbol, where the horizontal bar of the T represents the direction of the layer, and the vertical bar indicates the dip direction.

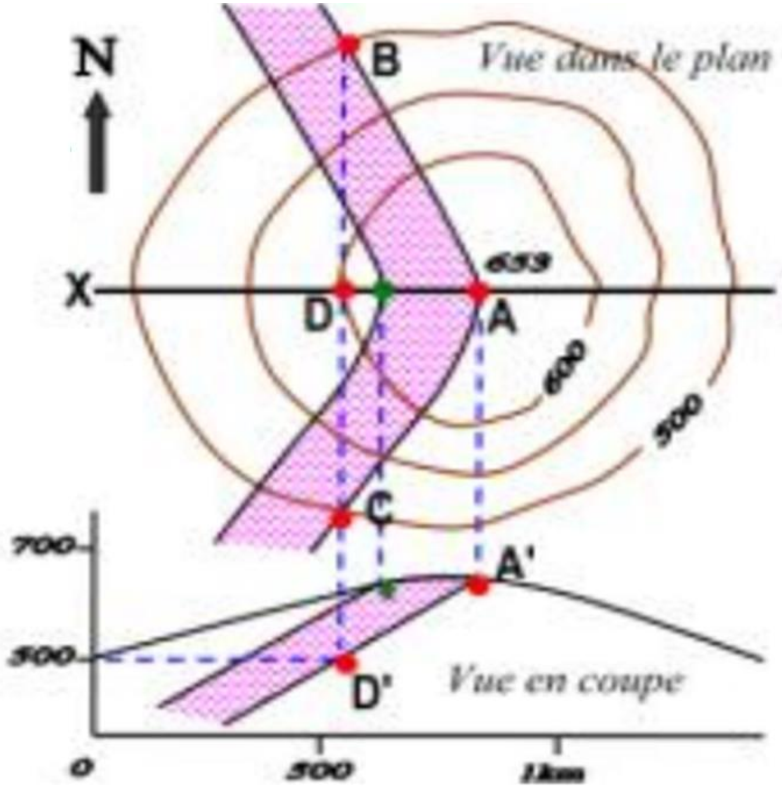


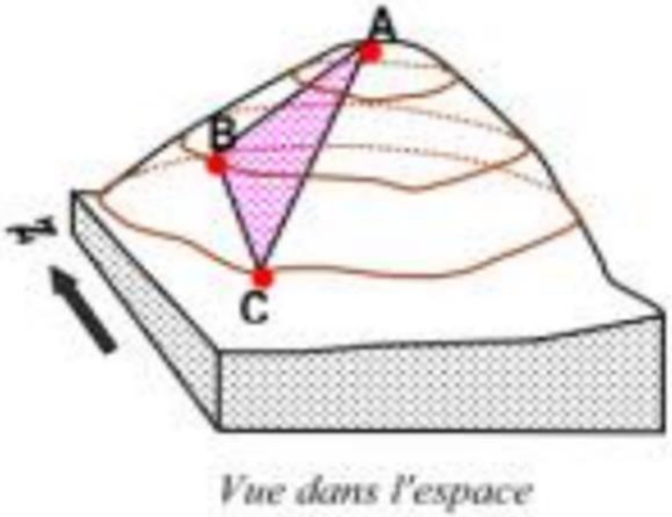
e: épaisseur de la couche;   L.aff: sa largeur d'affleurement

Determination of the dip of a layer using the three-point method:

- **Case of hilly topography:**

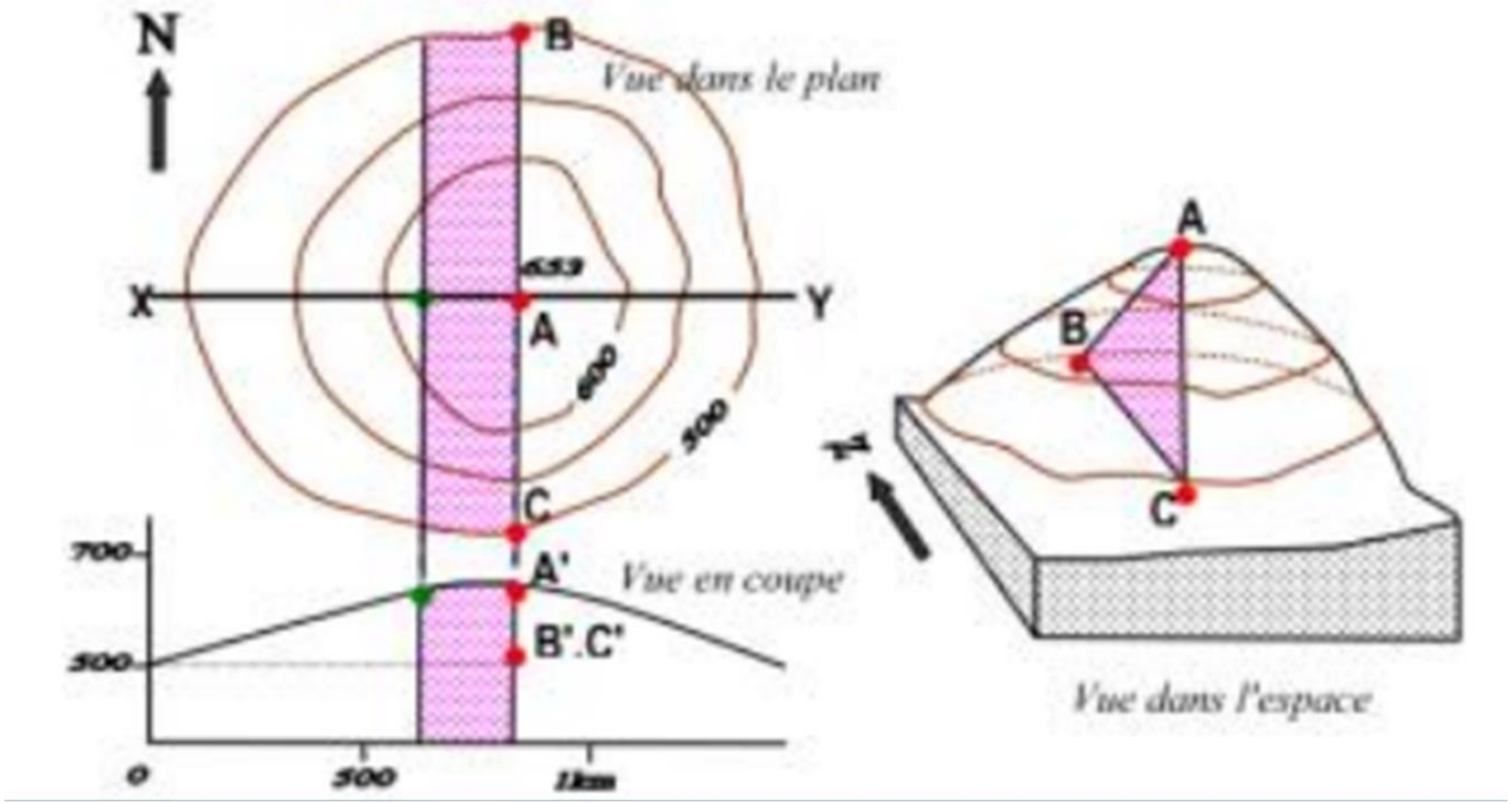
In order to define the plane corresponding to one of the boundaries of this layer, we will take 3 non-aligned points belonging to this plane, such that two are positioned at the same altitude and the third at a different altitude. Point A is at an altitude of 500m, while points B and C are on the contour line at 400m. These three points define a plane represented in section by AA', with the slope corresponding to the dip of the layer. In this case, the layer has a dip directed towards the west.





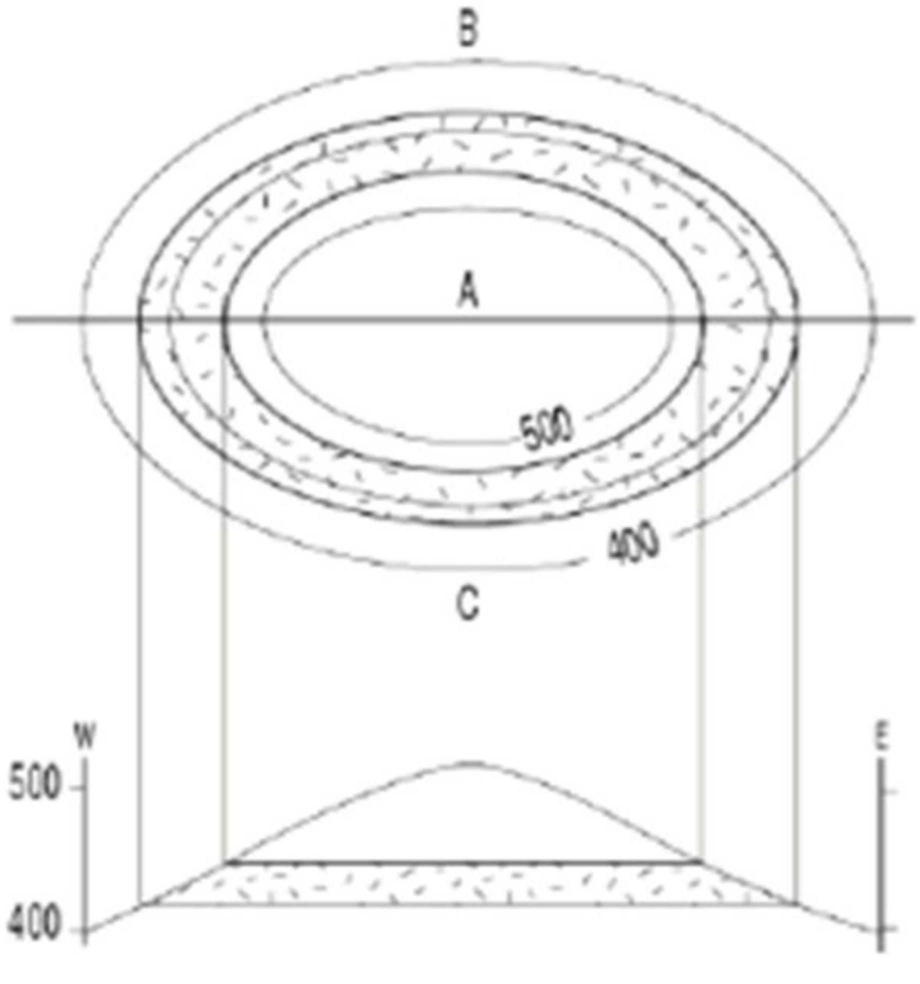
- **Case of a vertical layer:**

Geological boundaries in the case of a vertical layer will always have a straight-line representation on a map, regardless of the topography, as the projection of a vertical plane onto a horizontal plane (map) is necessarily a straight line.



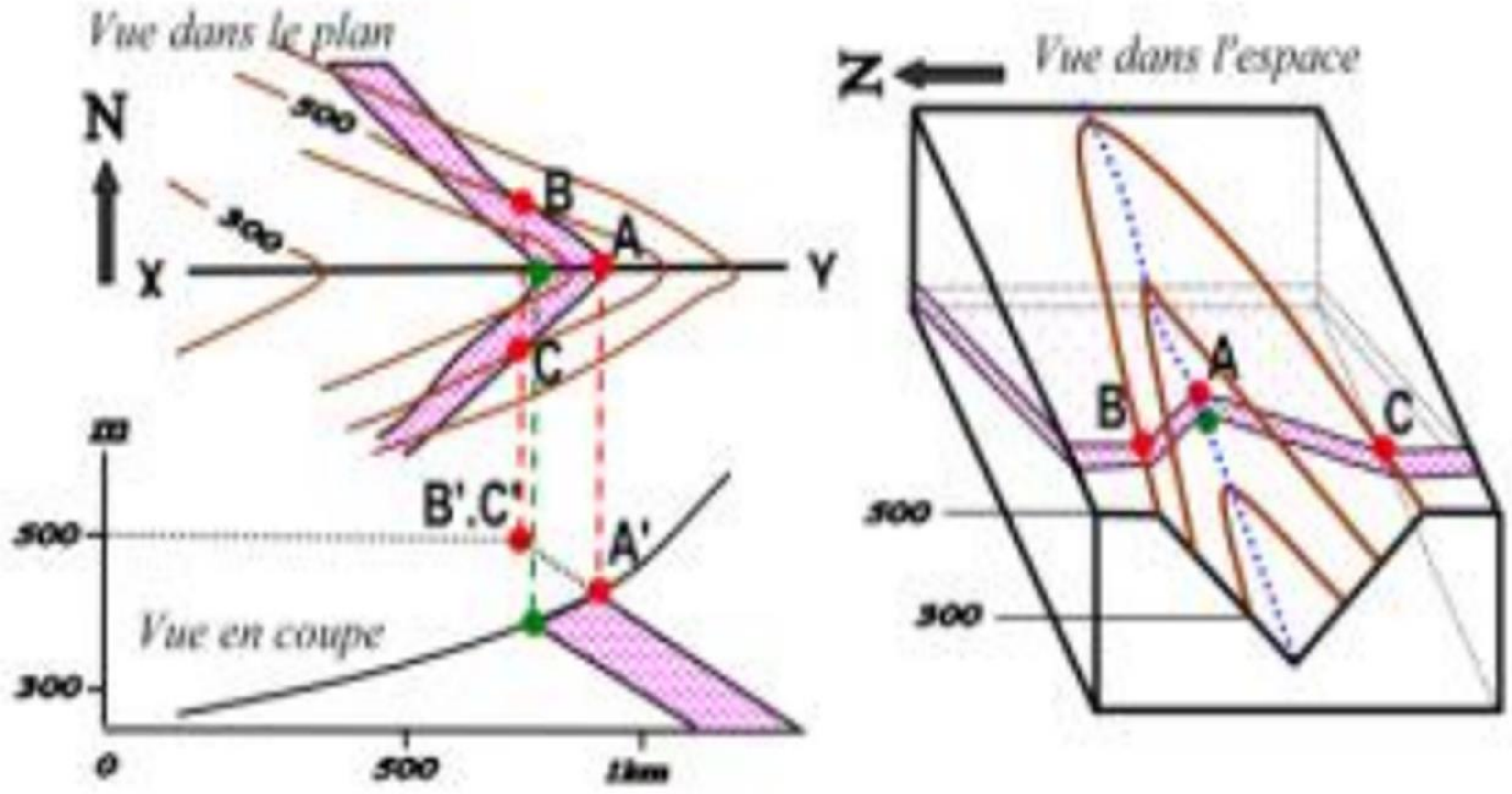
- **Case of a horizontal layer:**

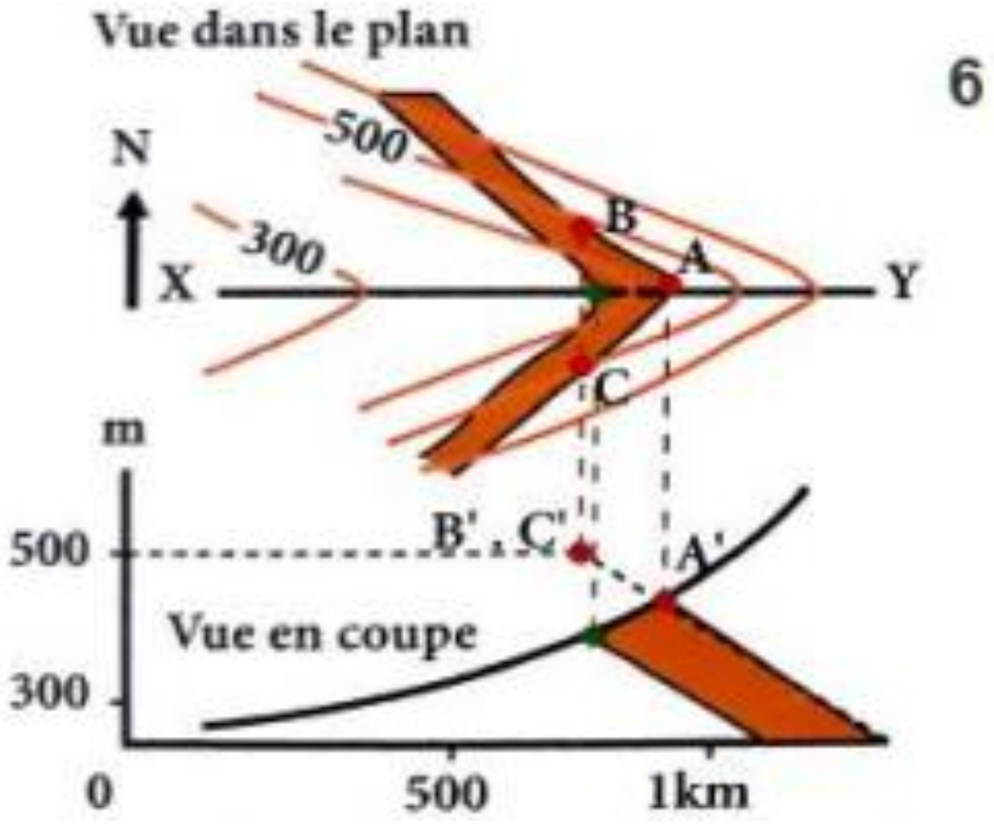
The boundaries of the layer are parallel to contour lines; therefore, all their points belong to two horizontal planes.

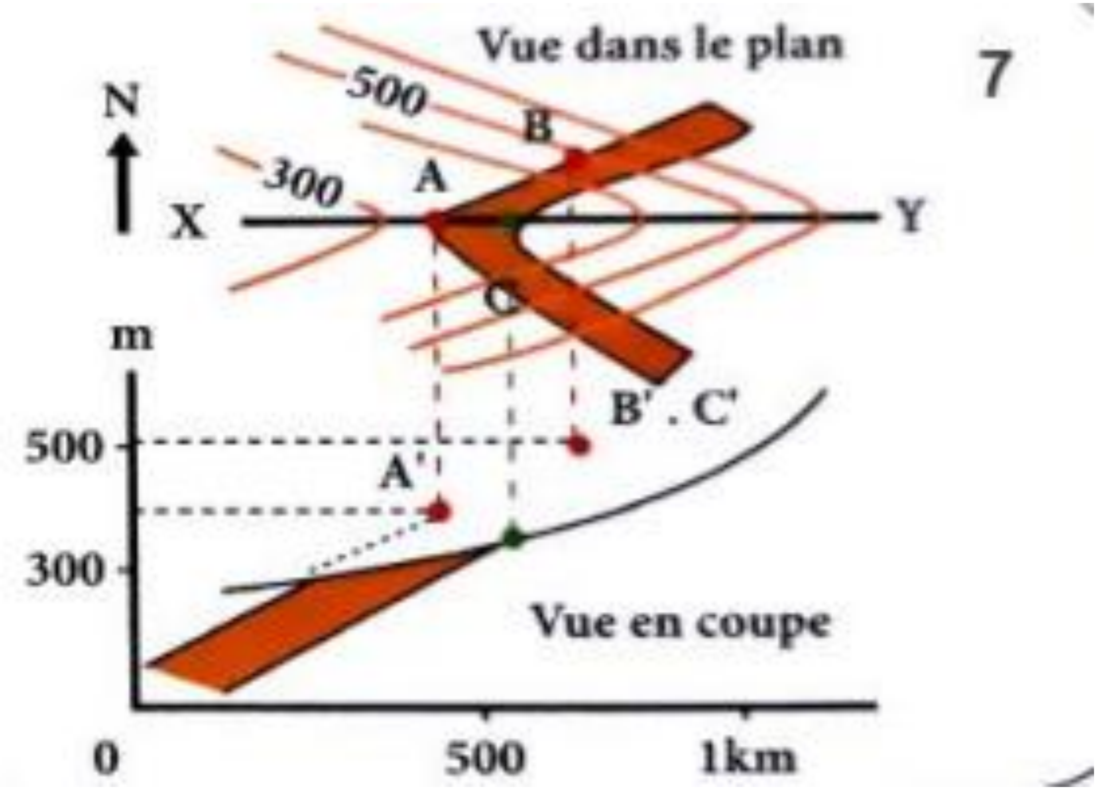


- **Case of topography in valleys:**

When an inclined layer crosses a valley, its boundaries form a V with the apex directed in the dip direction, except for particular cases: horizontal or vertical layers, and when the dip is in the same direction as the slope and is shallower than the slope.




Vue dans le plan
6
N
500
300
X
Y
B
A
C
m
500
300
B' . C'
A'
Vue en coupe
0
500
1km


Vue dans le plan
7
N
500
300
X
Y
A
B
C
m
500
300
B' . C'
A'
Vue en coupe
0
500
1km