# Basic Principles in Photointerpretation

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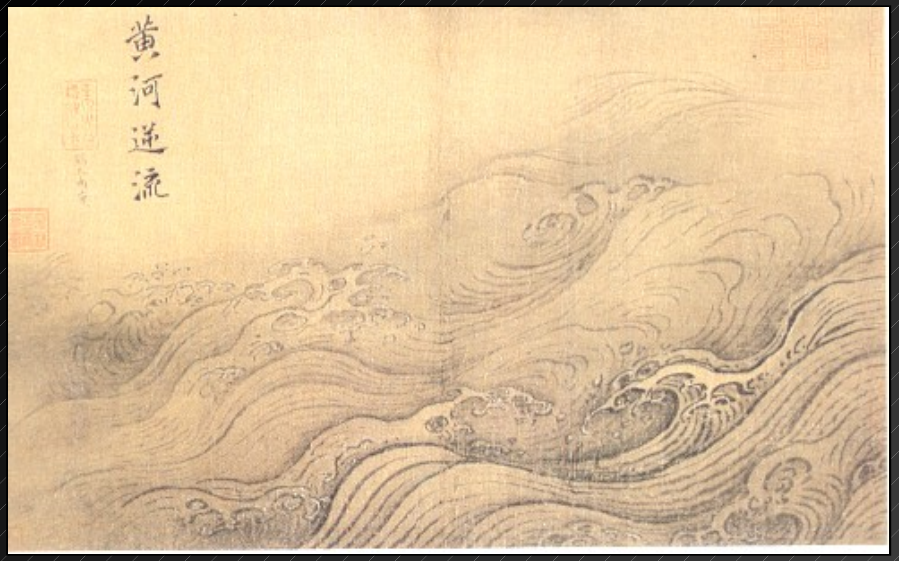
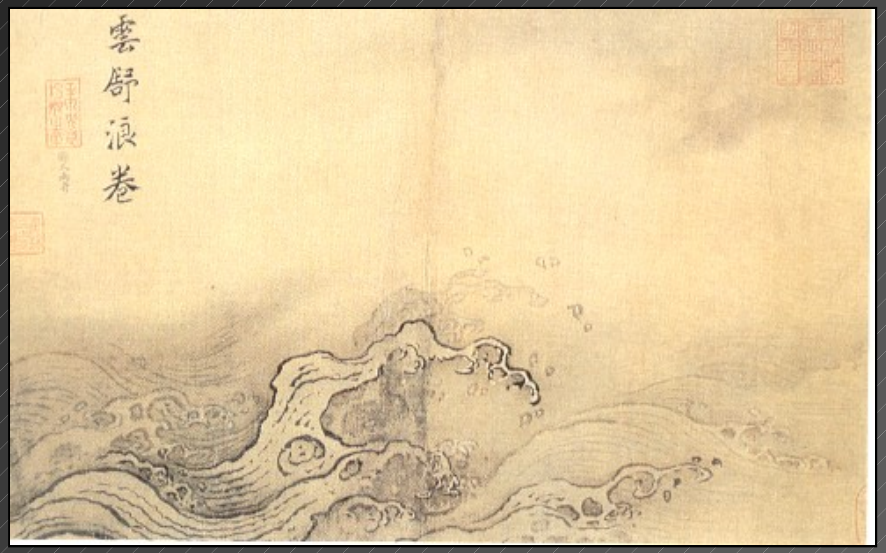
*UPMC, UPE, ENSG*



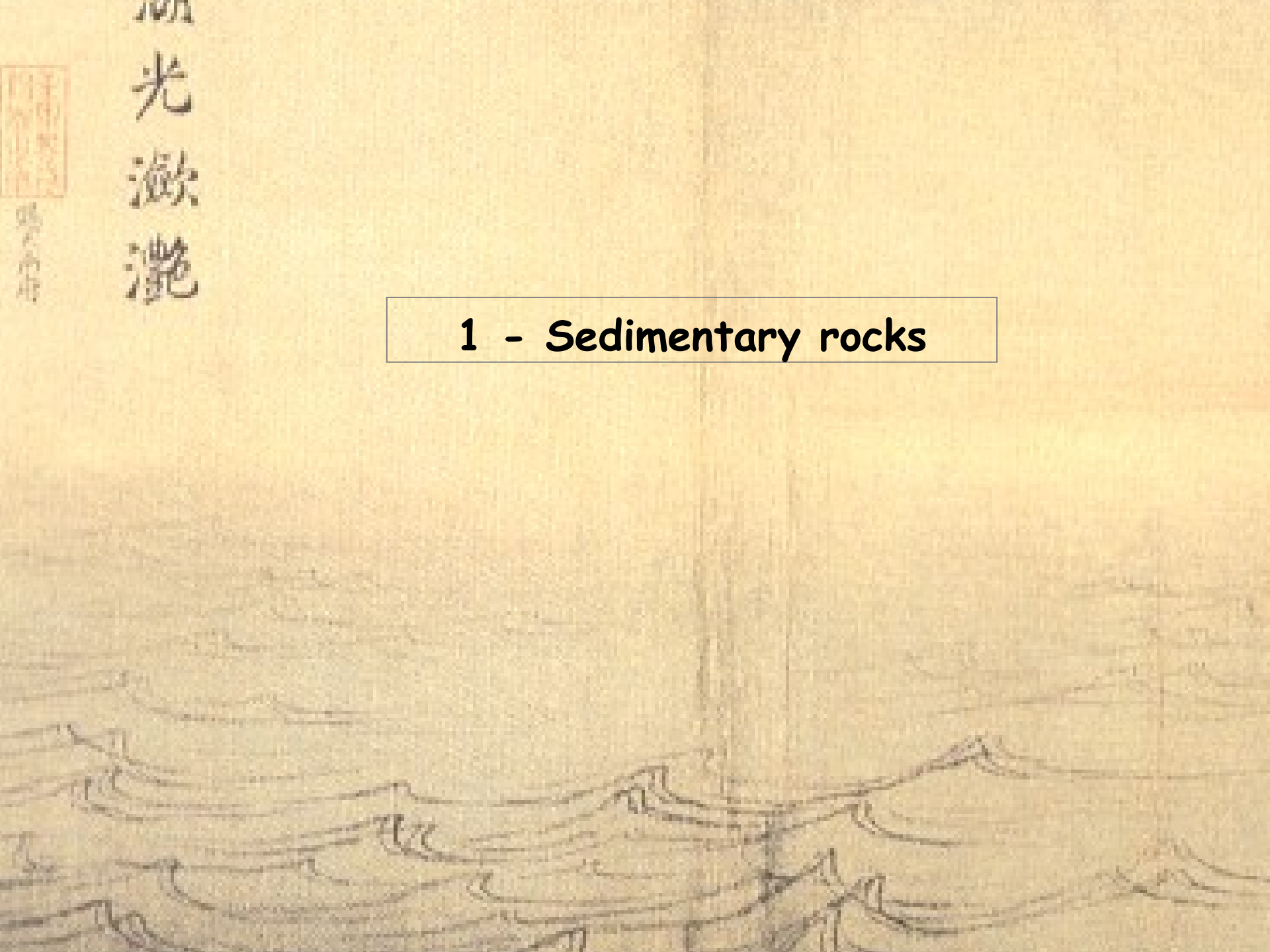

**« Clefs de lecture pour une meilleure compréhension du paysage »**

Introduction
1- Lithologie : Roches sédimentaires, magmatiques et métamorphiques
2- Structure
3 – Chronologie
Conclusions

# Introduction :
# Major rock families

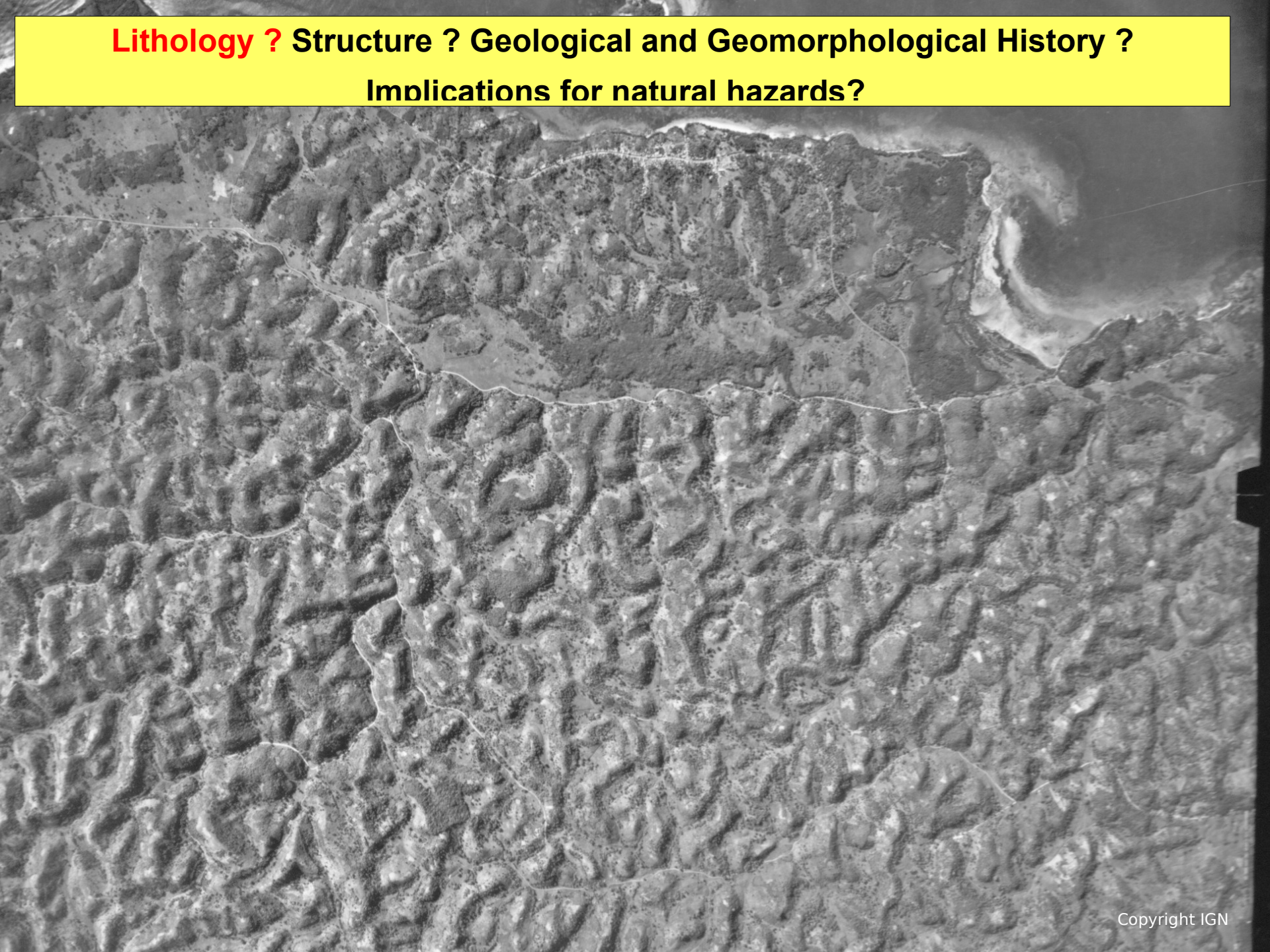
1. **Sedimentary rocks :**
   - **Clastics :** Shales, Sands, Sandstones
   - **Non clastics :** Limestones, Evaporites
2. **Magmatic rocks:**
   - **Plutonic rocks** : e.g. granite
   - **Volcanic rocks** e.g. Basalts, Andesites, Rhyolites etc…;
3. **Metamorphic rocks** (schists, quartzites, marbles, metaevaporites, gneiss, metabasalts, metaandesites…)

# 1 - Sedimentary rocks



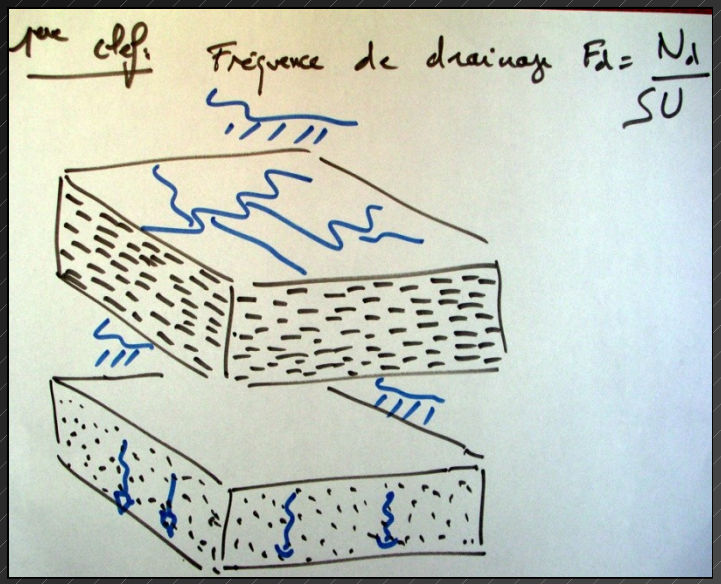
**Lithology ? Structure ? Geological and Geomorphological History ?**

**Implications for natural hazards?**



# « Key one Lithology » = Drainage frequency

- Drain number (Nd) by surface unit (SU) reveals : the permeability



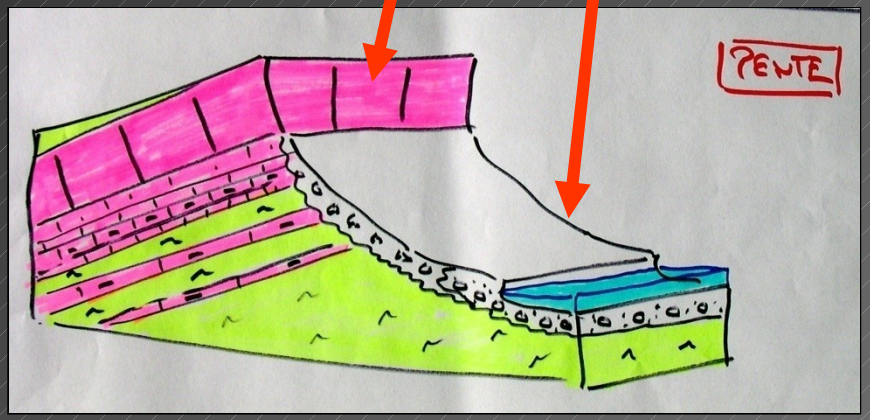

**High drainage frequency means impermeability** of layers (e.g. Clays or Marls)

**Low drainage frequency means high permeability**, water infilter in the soil and the rocks (such as sands, sandstones or limestones).


Miller and Miller photogeology

# « Key 2 Lithology »
# Slope = rocks hardness

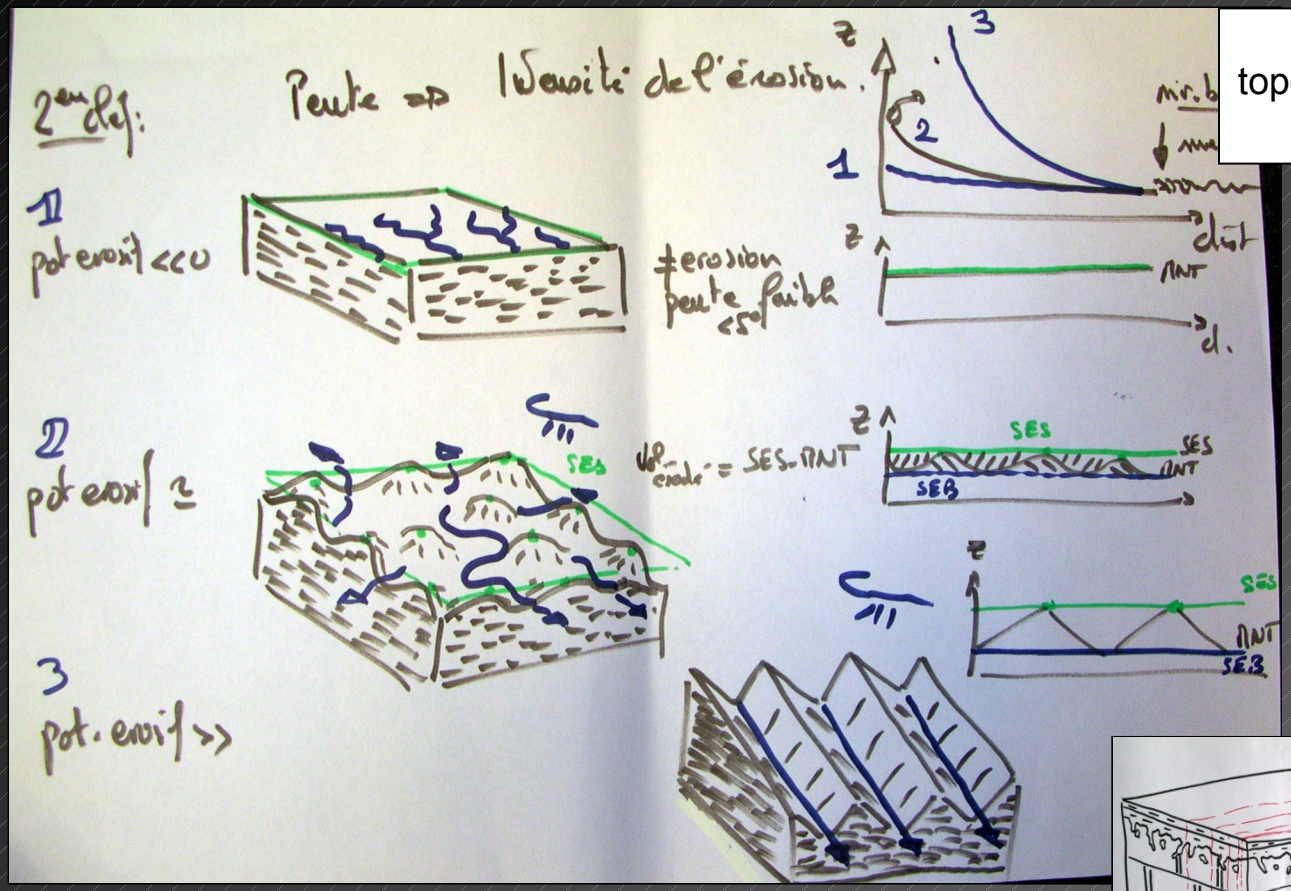
Alternance of hard and soft rocks



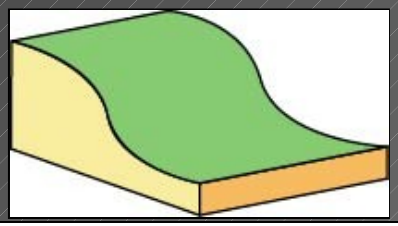

- **Low slope** = soft rocks. The depression is composed of clays or marls.
- **Scarp or high slope value** = hard rock e.g. limestone or sandstones.

# « Key 3 Slope » = also Erosion intensity on both hard and soft rocks

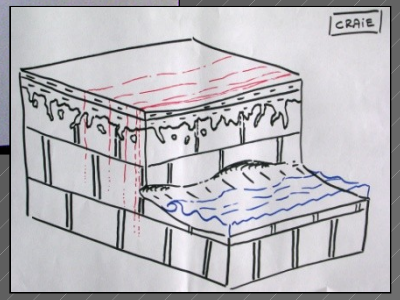
**Erosive potential** correspond to the difference of altitude between the higher and the lower altitudes of the drainage basins.




**subhorizontal** topography if low erosive potential (plain)



Convex-concave slope if intermediate erosional intensity



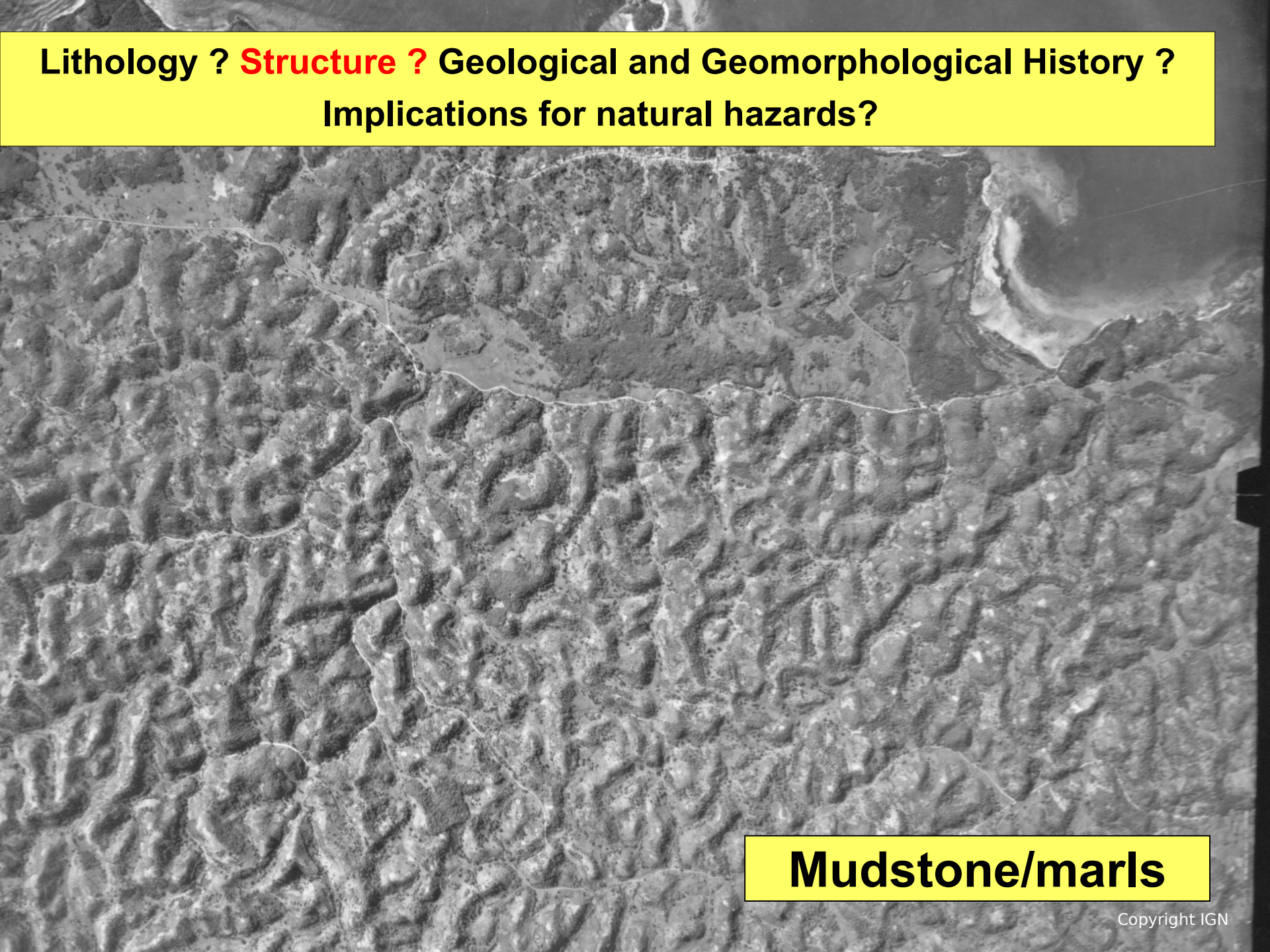

Dip slope or scarp if a major erosive potential (badlands)

# Lithology

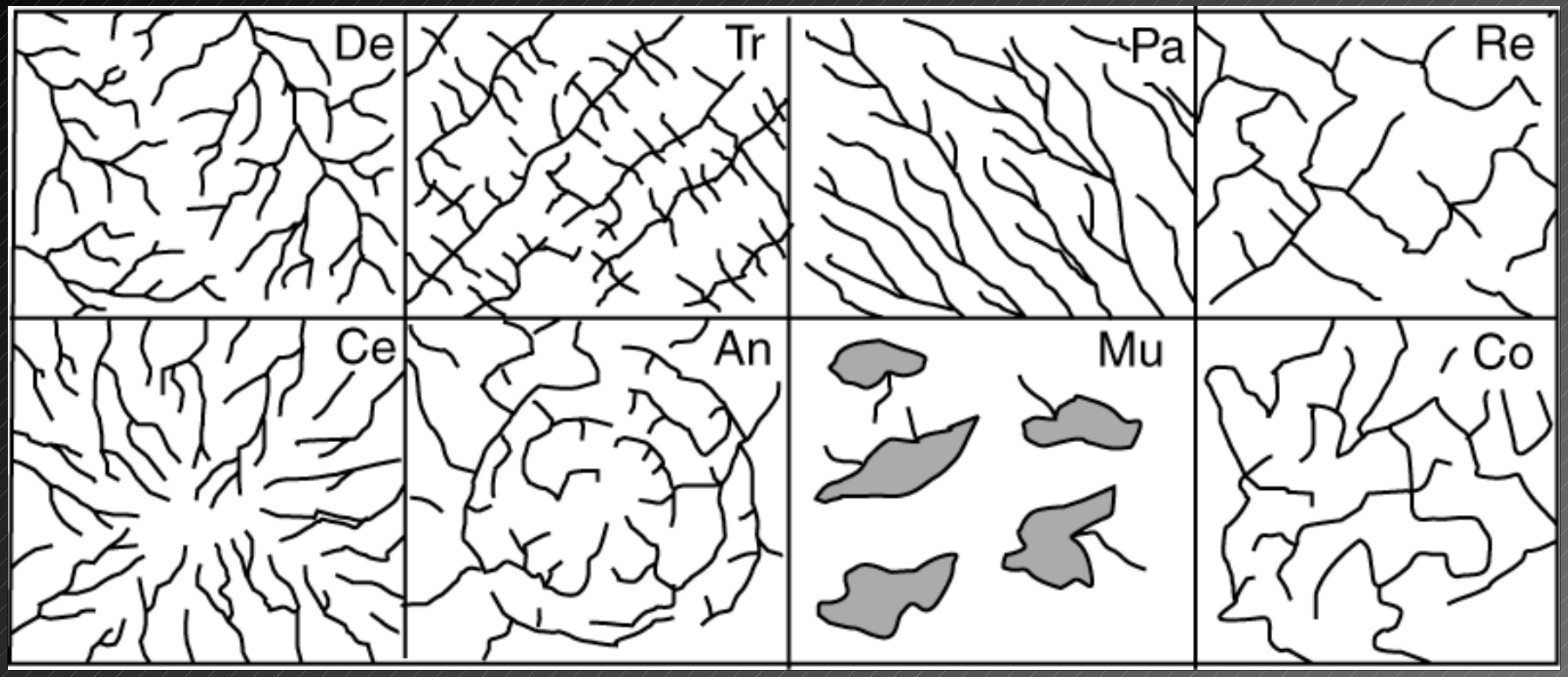
Continental clays or silts

**Lithology ? Structure ? Geological and Geomorphological History ?**

**Implications for natural hazards?**



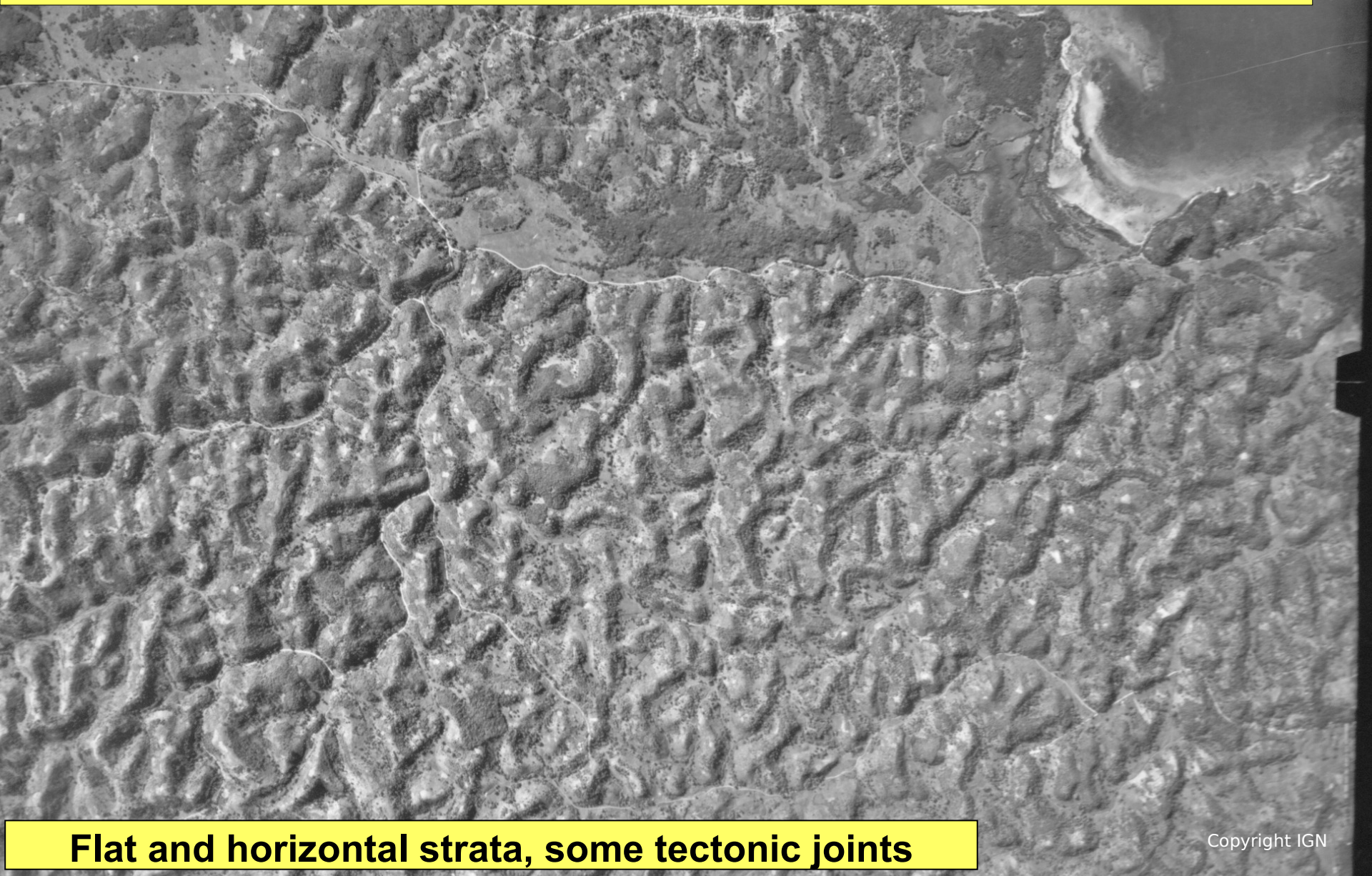
# « Key 4 Structure » = Drainage network and anomalies




De= Dendritic (flat horizontal isotropic surface); Pa= Parallel more than 8% topographic slope; An= Annular dome-antiform; Ce= Centrifugal: Dome; Mu= Multibasinal surface just exonded.; Tr Trellis directerd by tectonic joints; Re = Reticulate (composite geneticaly); Co Contorted by neotectonic.

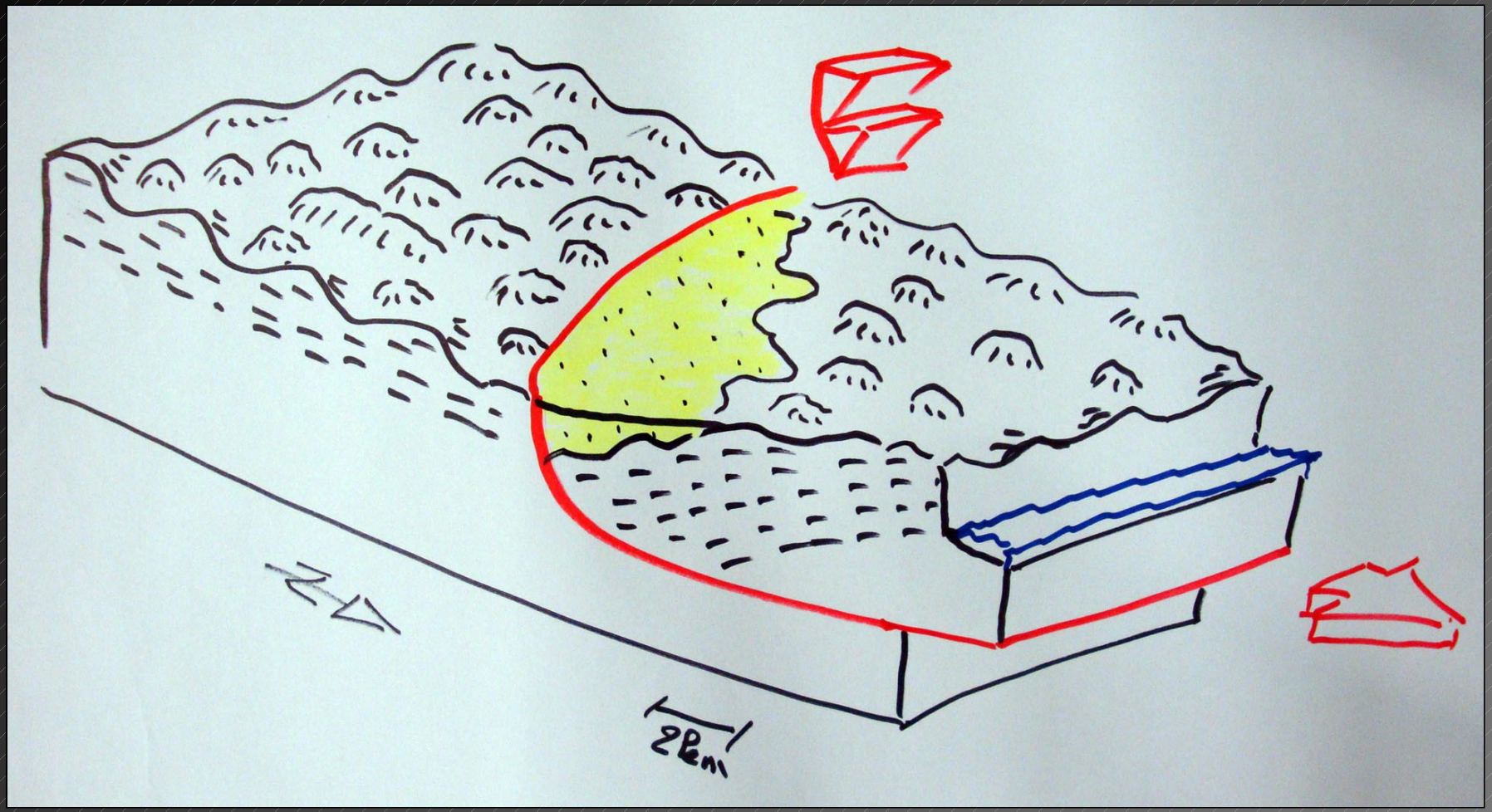
**Lithology ? Structure ? Geological and Geomorphological History ?**

**Implications for natural hazards?**



**Flat and horizontal strata, some tectonic joints**

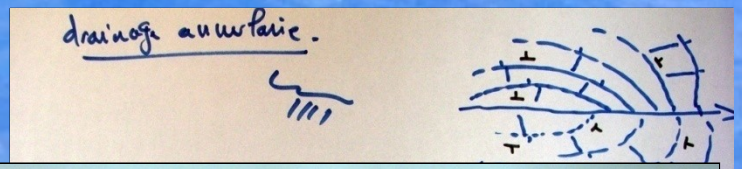
# 3D view of the studied area

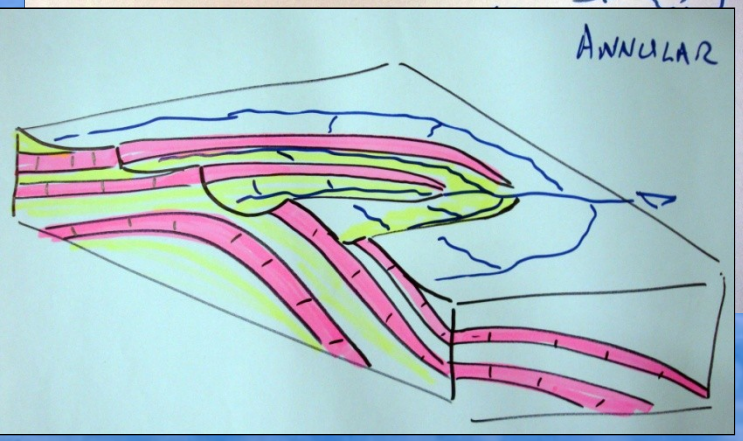


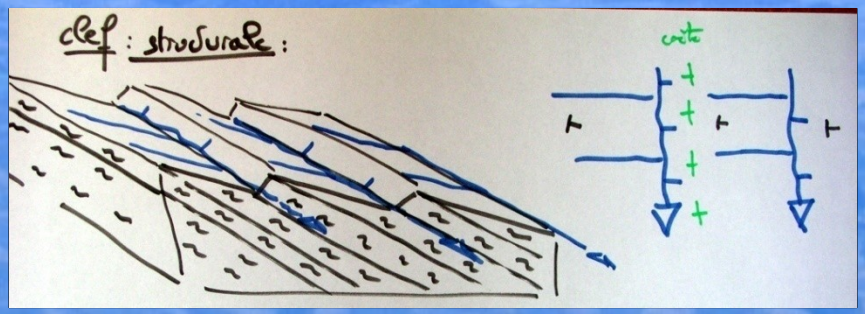
# Lithology and structure ?

# Clays, Silts or Marls

# Structure ?




· High drainage frequency = impermeable; Homogenous and uniform : only one kind of rock; Transverse profile : soft rocks (no scarpss)., subhorizontal SLS + hgih amplitude cret/talweg = Strong erosion;

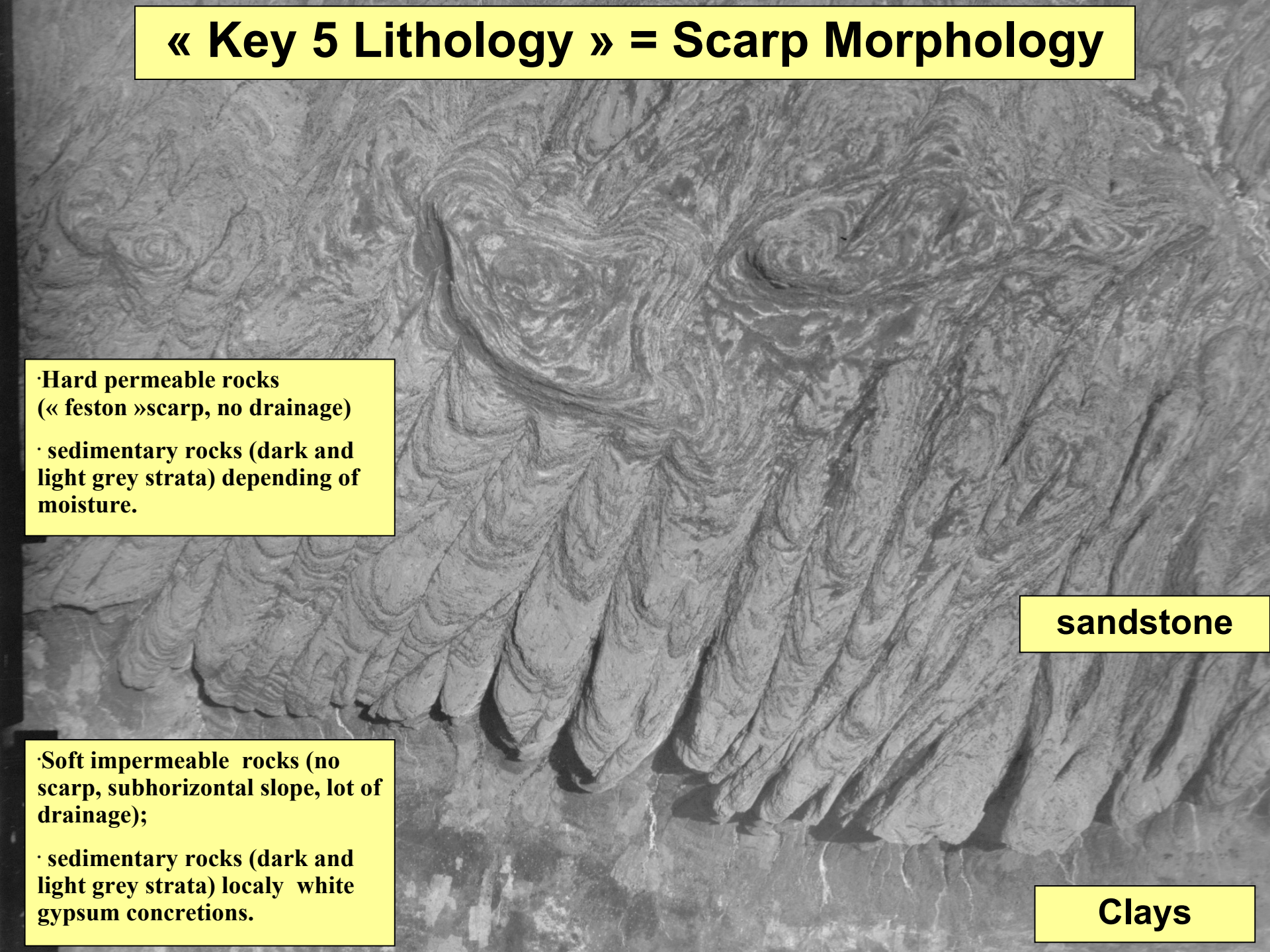
· Annular dissymetric drainage linked to structural fold (tilted bedding and fold and antiform axis);

· Facets and active fault on top right.

# Silts, clays and marls

- High drainage frequency : All the precipitation runoff on rivers so **impermeable rocks;**
- Relief Uniform and Homogenous : only one kind of rock outcropping;
- No scarps = **soft rocks** and convexo-concave flank and low creste-talweg distance so soft **rocks**;
- **Low slope of the subhorizontal SLS** : Slow regular erosion;
- **Possible geological Scenarii :** deposition of the Silts/clays/marls below sea level then (1) surrection due to tectonic compression and/or (2) regression due to colder climate and water storage in both poles and mountains.

# « Key 5 Lithology » = Scarp Morphology



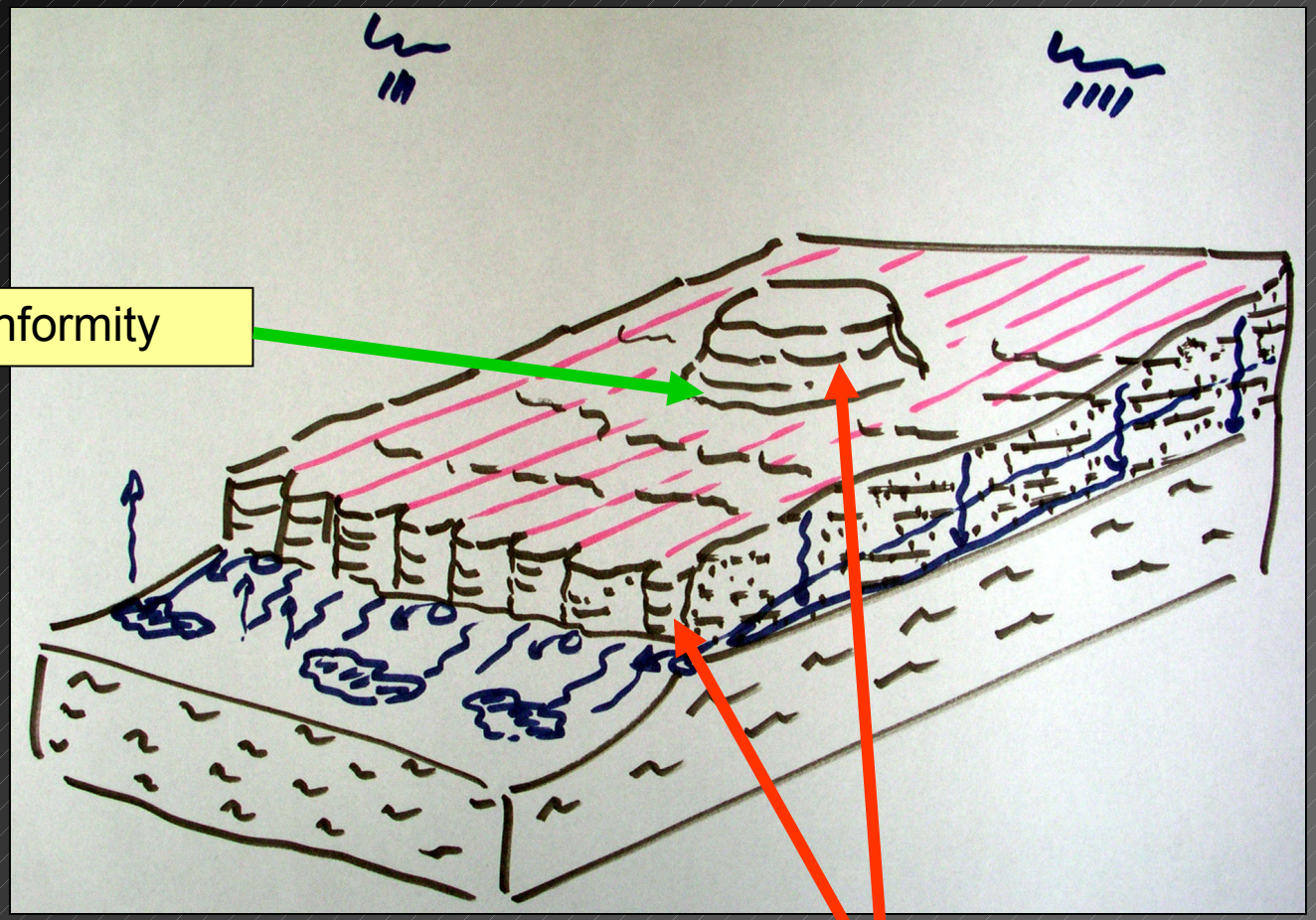

·Hard permeable rocks
(« feston »scarp, no drainage)

· sedimentary rocks (dark and light grey strata) depending of moisture.

·Soft impermeable rocks (no scarp, subhorizontal slope, lot of drainage);

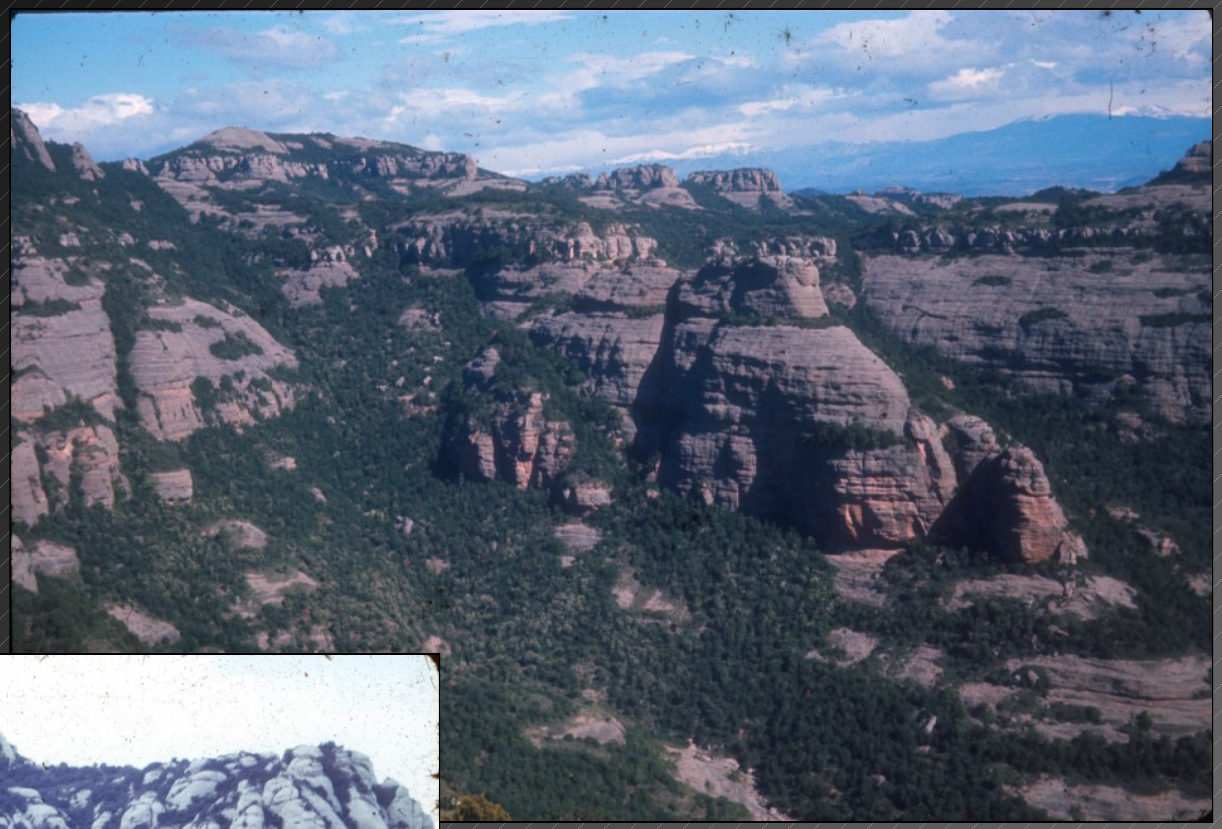
· sedimentary rocks (dark and light grey strata) localy white gypsum concretions.

# Scarp morphology from a planimetric point of view



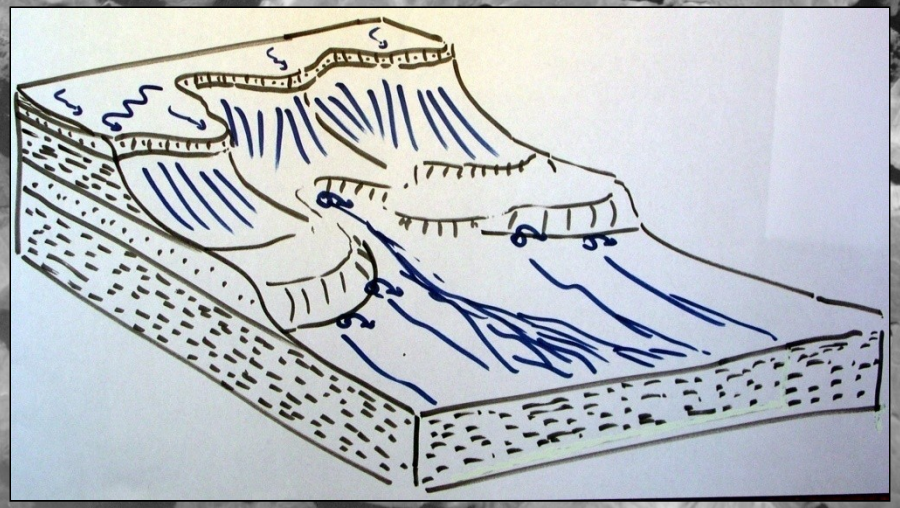
Unconformity

Sandstones : hard permeable rocks characterized by a « feston » scarp

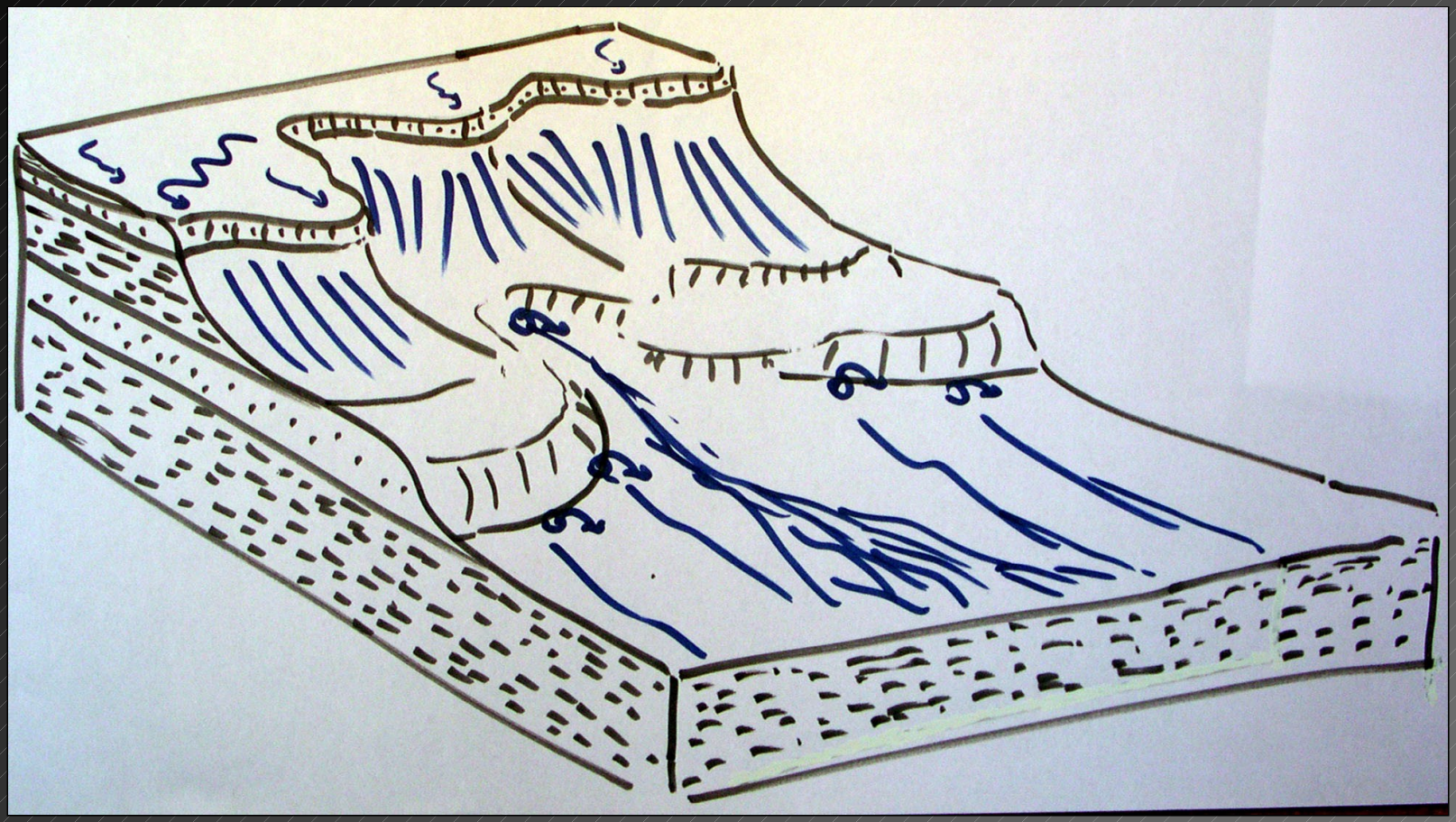


**Sandstones**

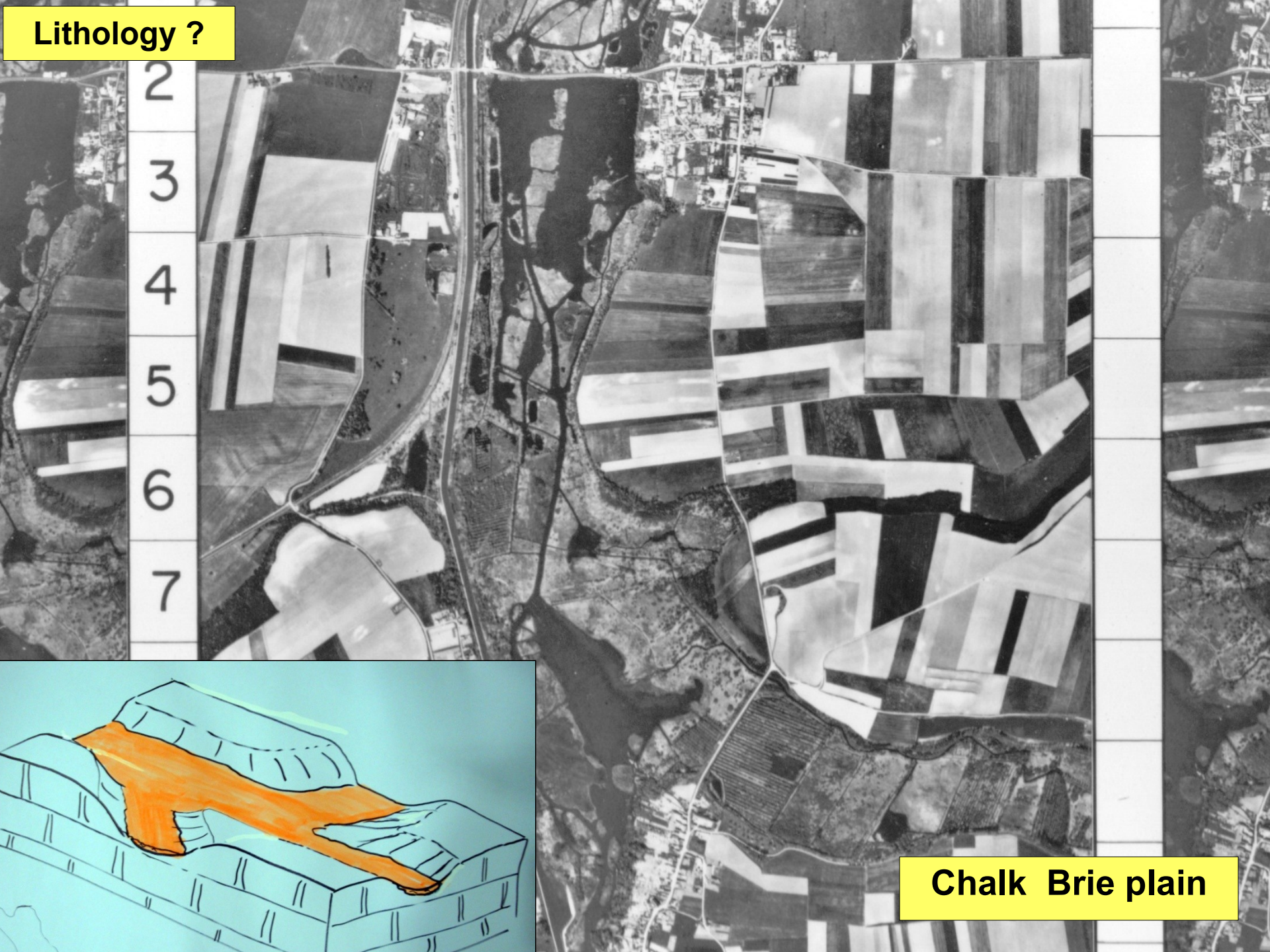
# Morphology of the scarp : Sandstones and Clays Alternance



« Steps flank» : hard and soft rocks alternance e.g. (1) sandstones (scarps permeable rocks) and (2) clays/silts soft and impermeable. Drainage in blue.

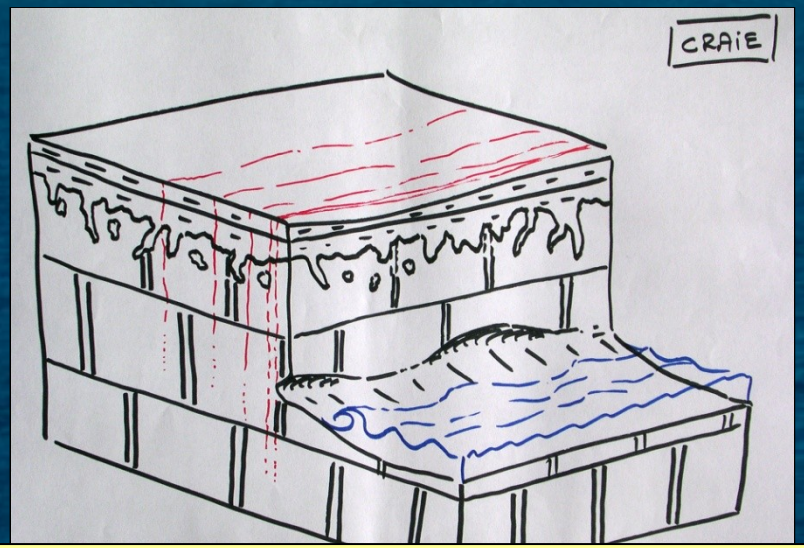


Importance in term of Oil system – source rock, reservoir and cover/caprock


Lithology ?
2
3
4
5
6
7
Chalk Brie plain

Chalk - Brie (France)

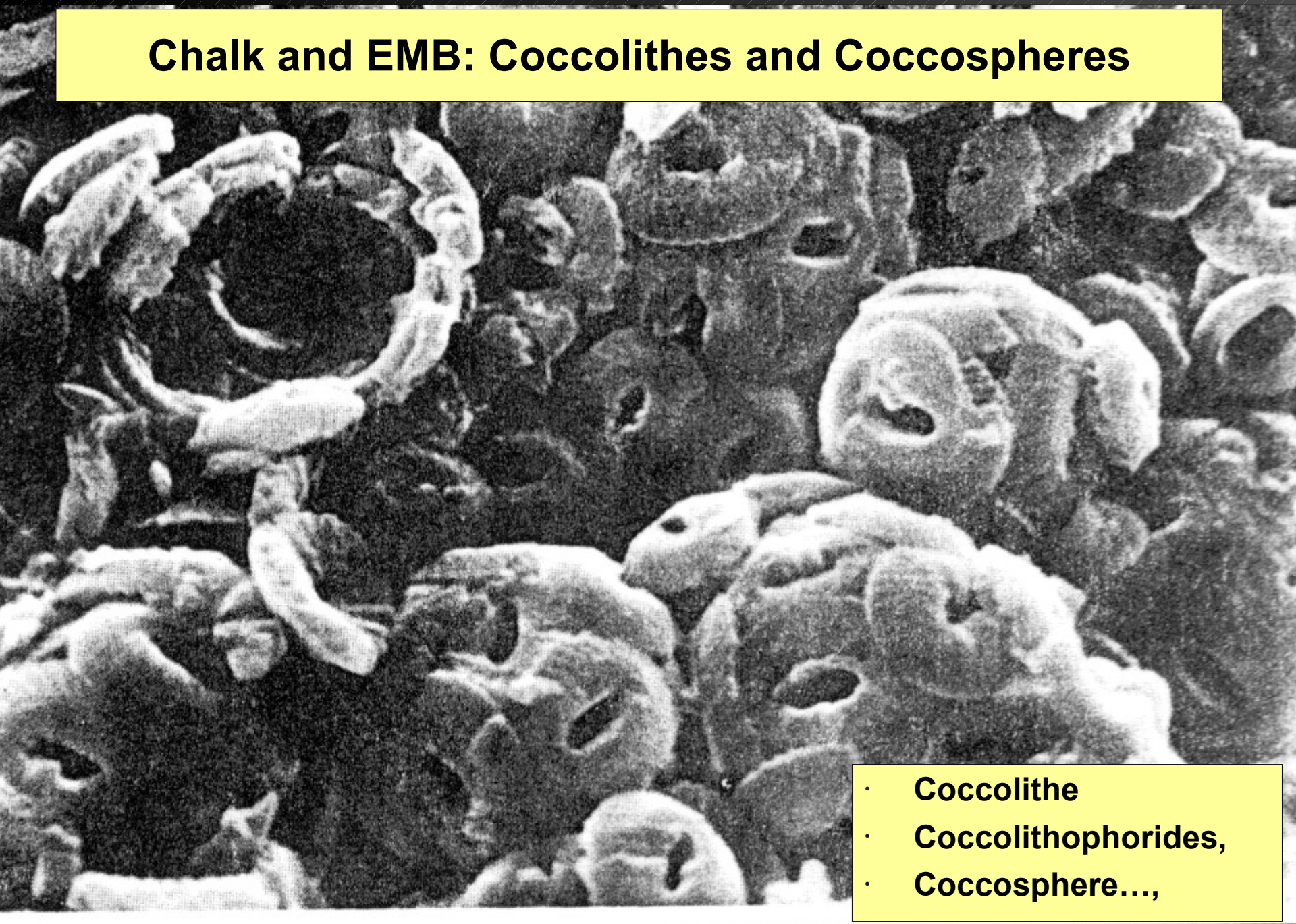
## Cliff Processes :




undercaving, dissolution and decompression

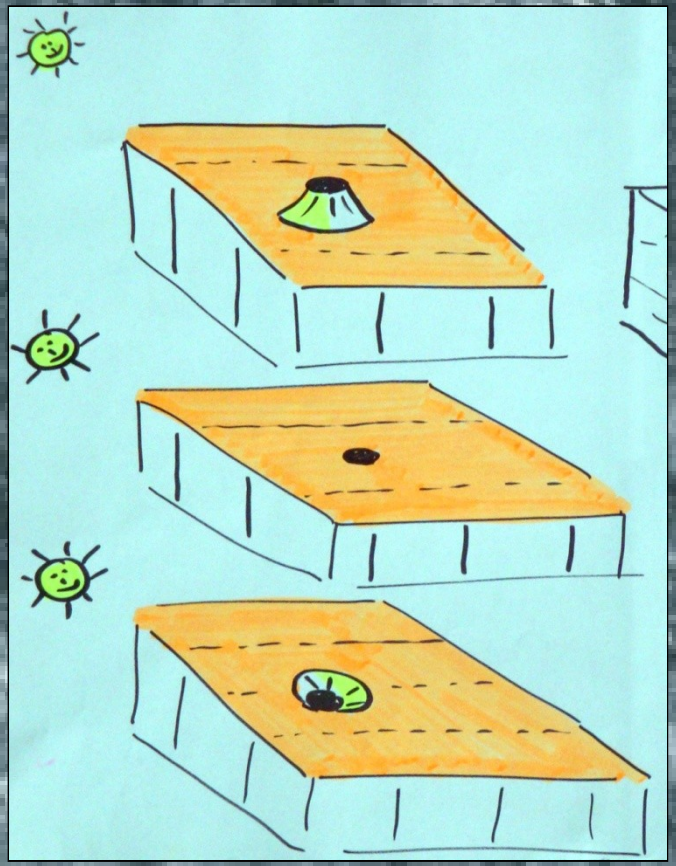
**Chalk Wessex basin**

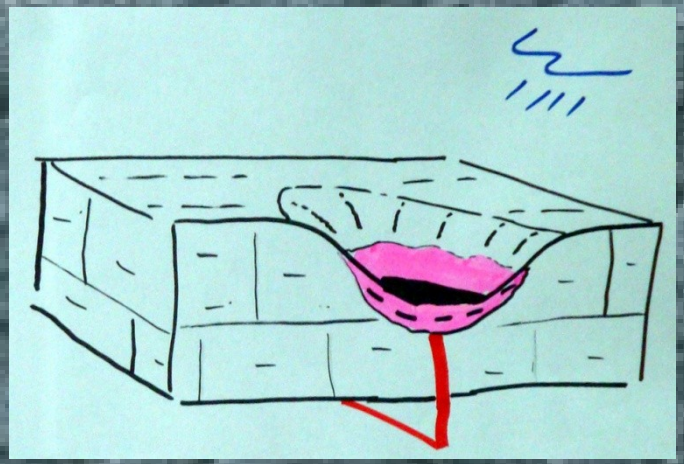
# Chalk and EMB: Coccolithes and Coccospheres

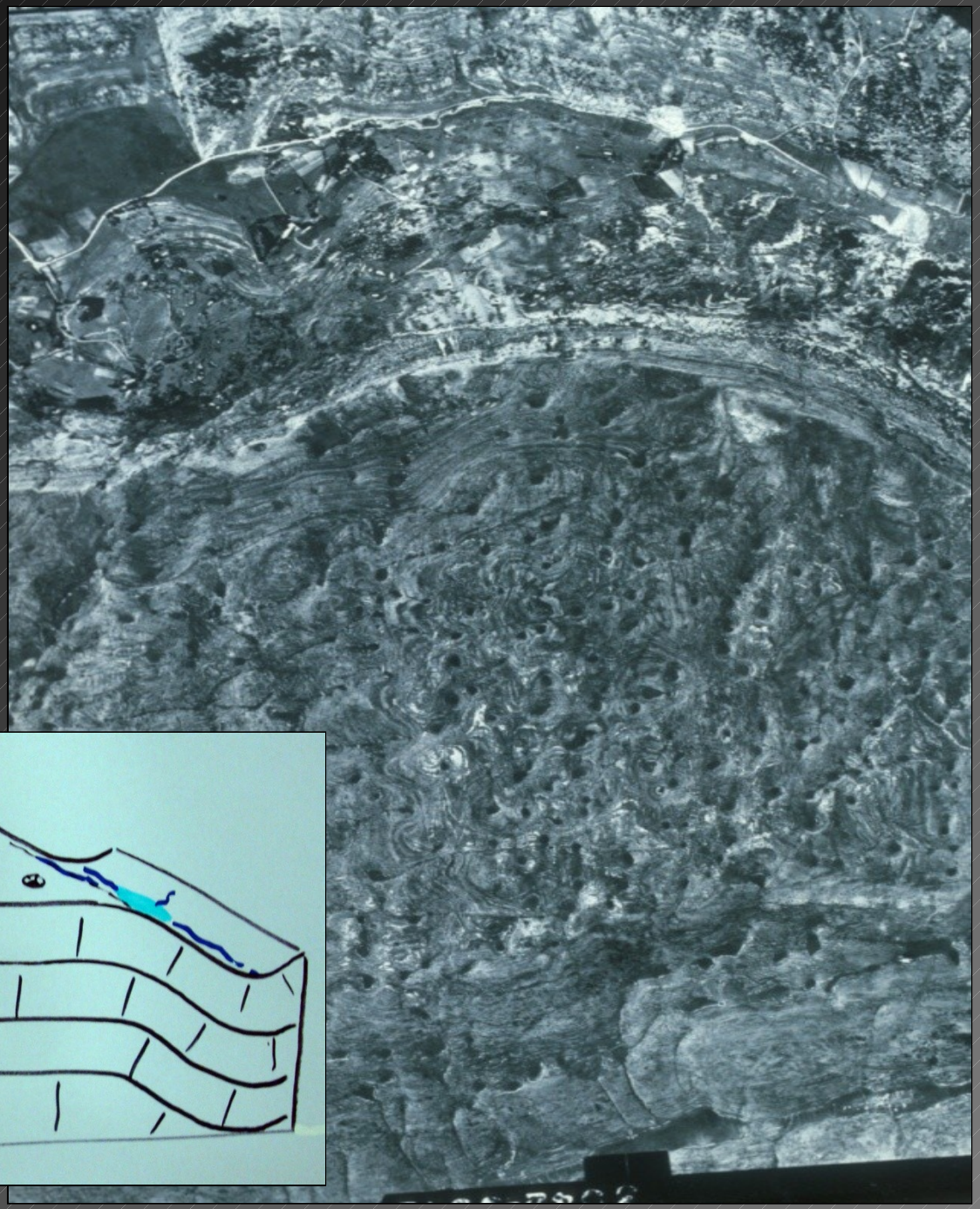


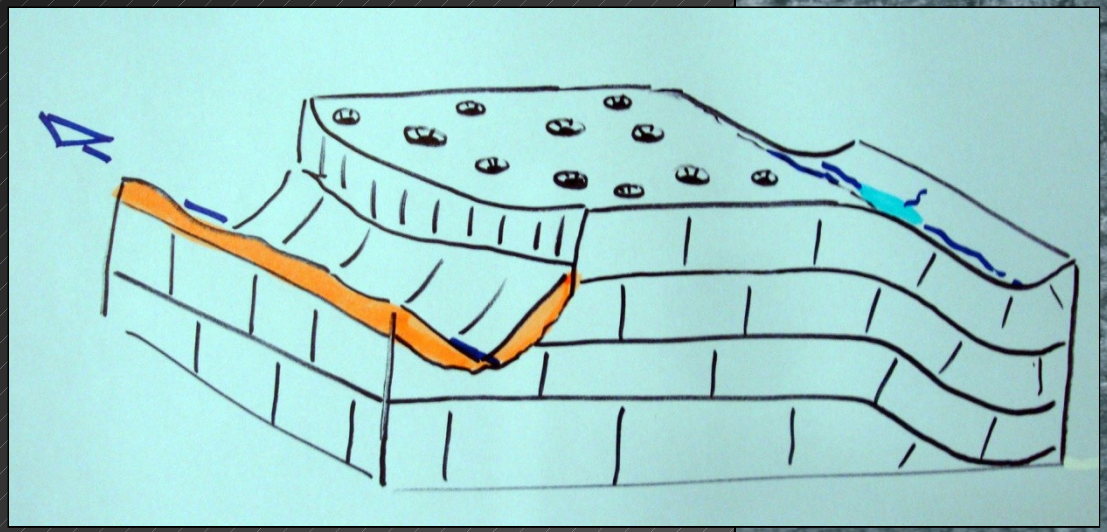
- Coccolithe
- Coccolithophorides,
- Coccosphere…,

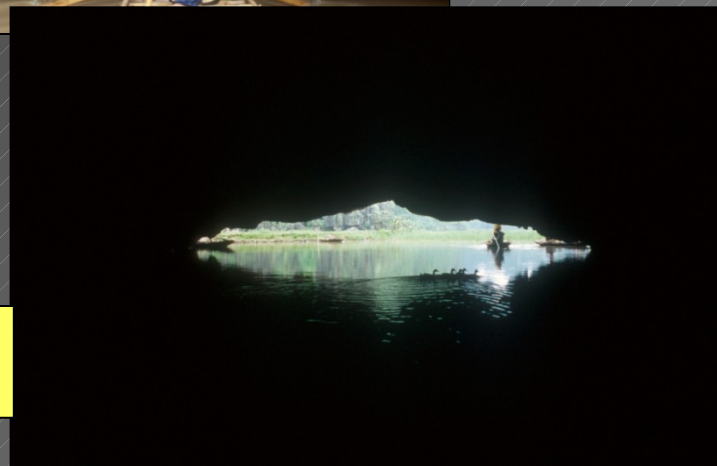
# Lithology ?





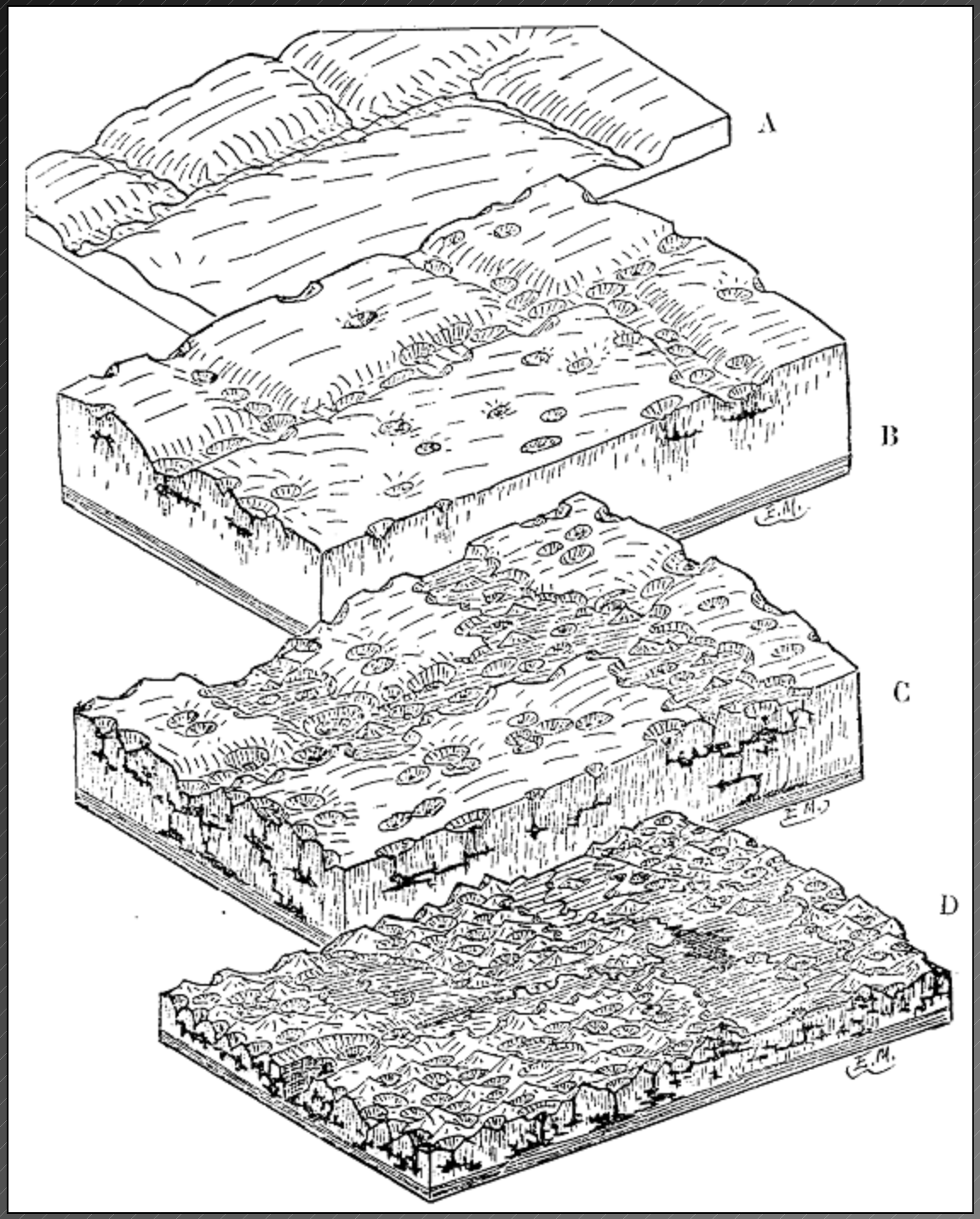




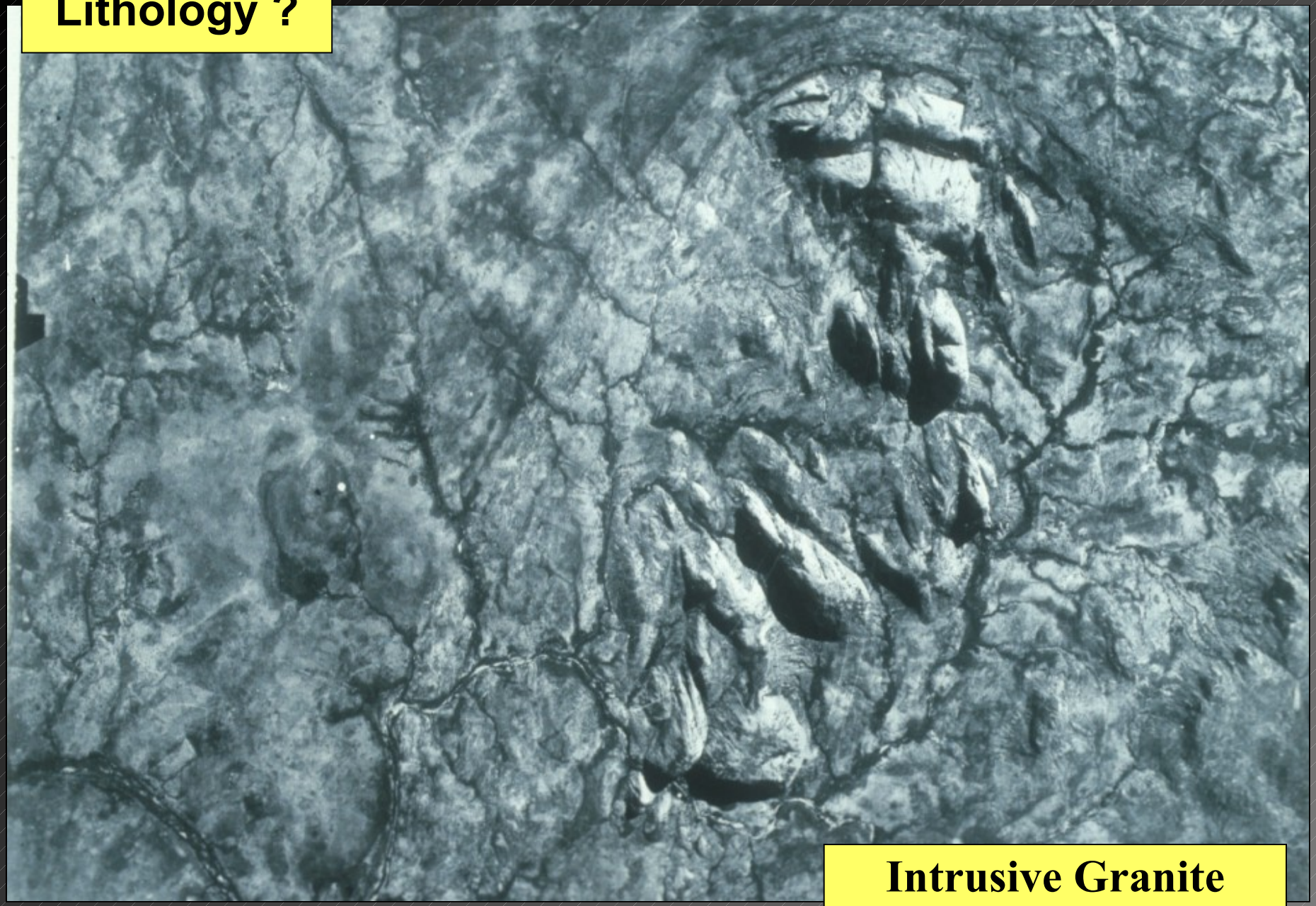
# Limestone - Karst

# Carbonates Evolution



# 2 - Magmatic rocks : Plutonic ones

Lithology ?



Intrusive Granite

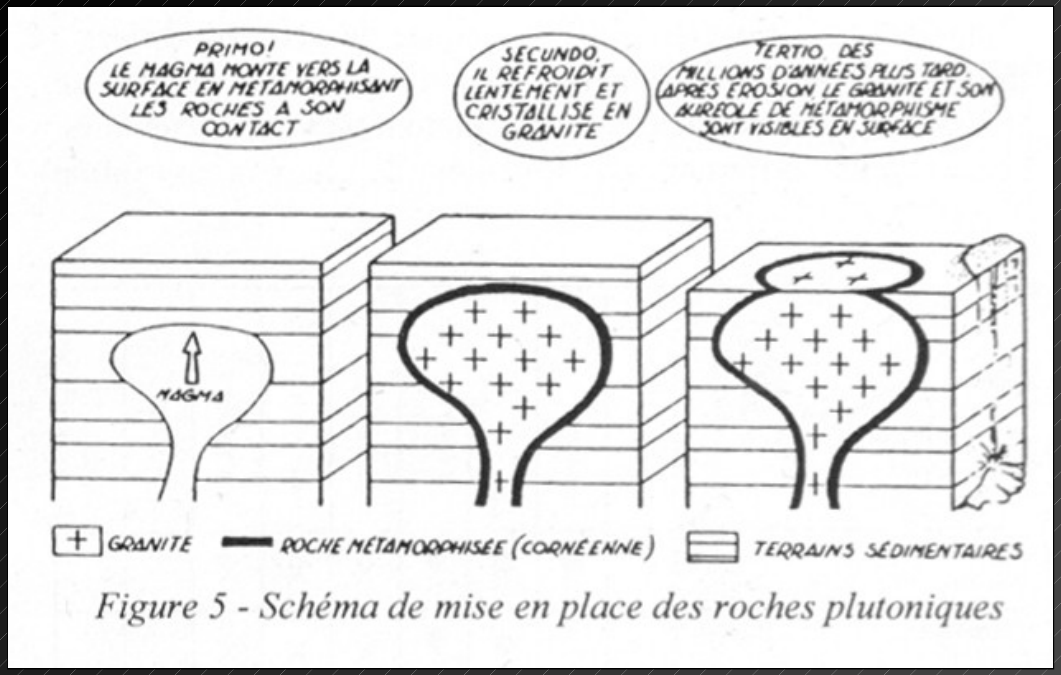
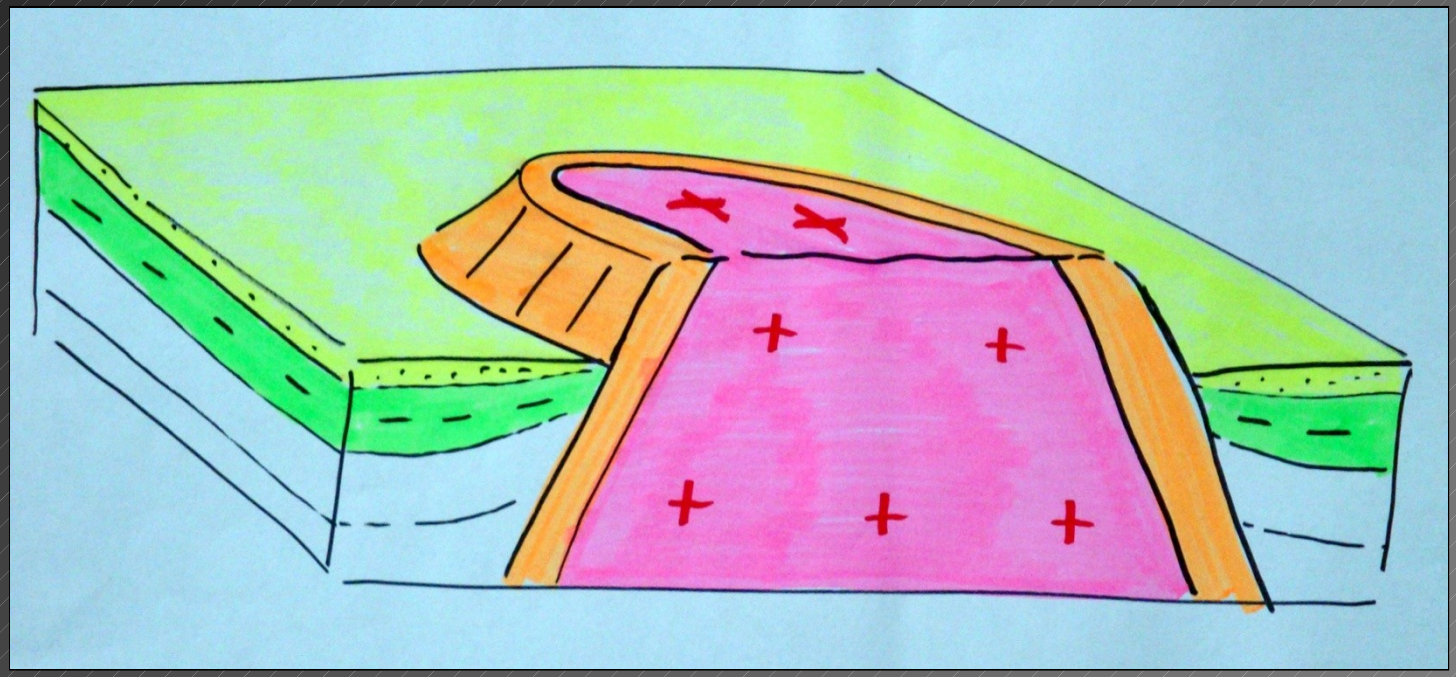
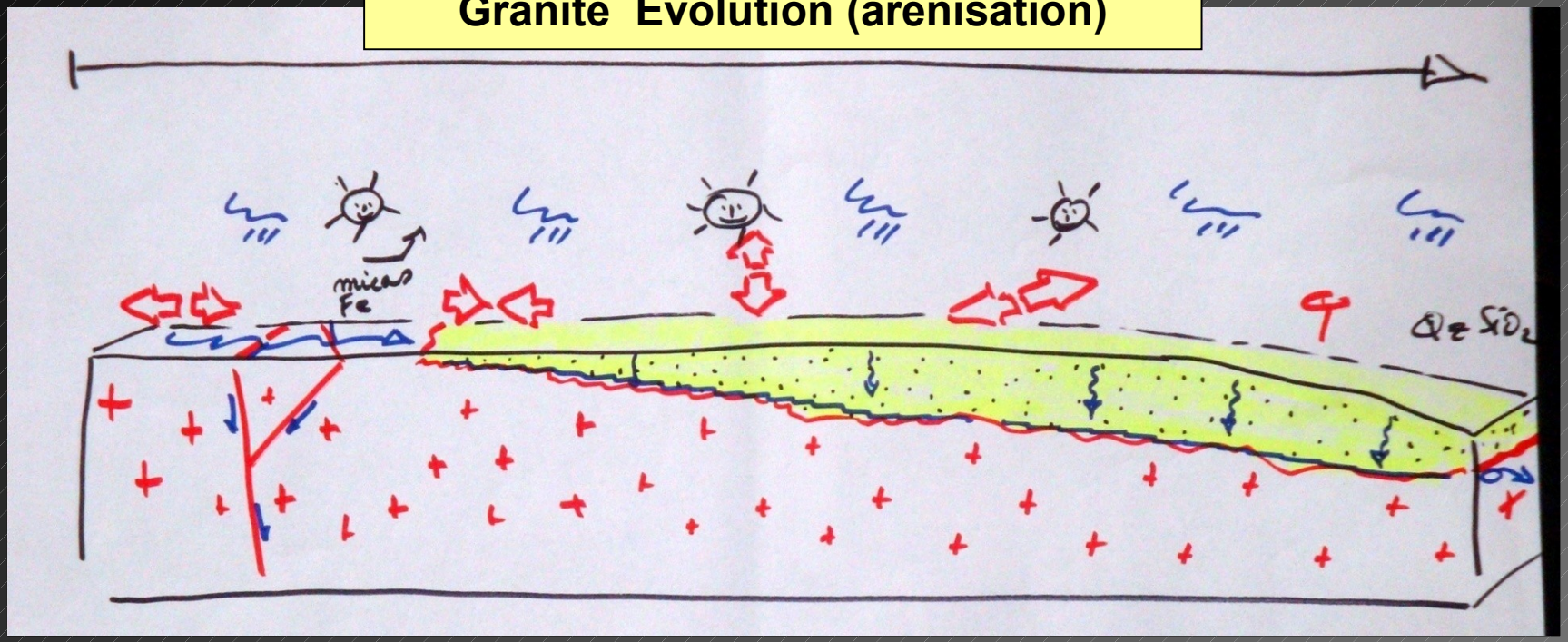



*Figure 5 - Schéma de mise en place des roches plutoniques*

**Intrusive Granite + Contact metamorphism**



# Granite Evolution (arenisation)

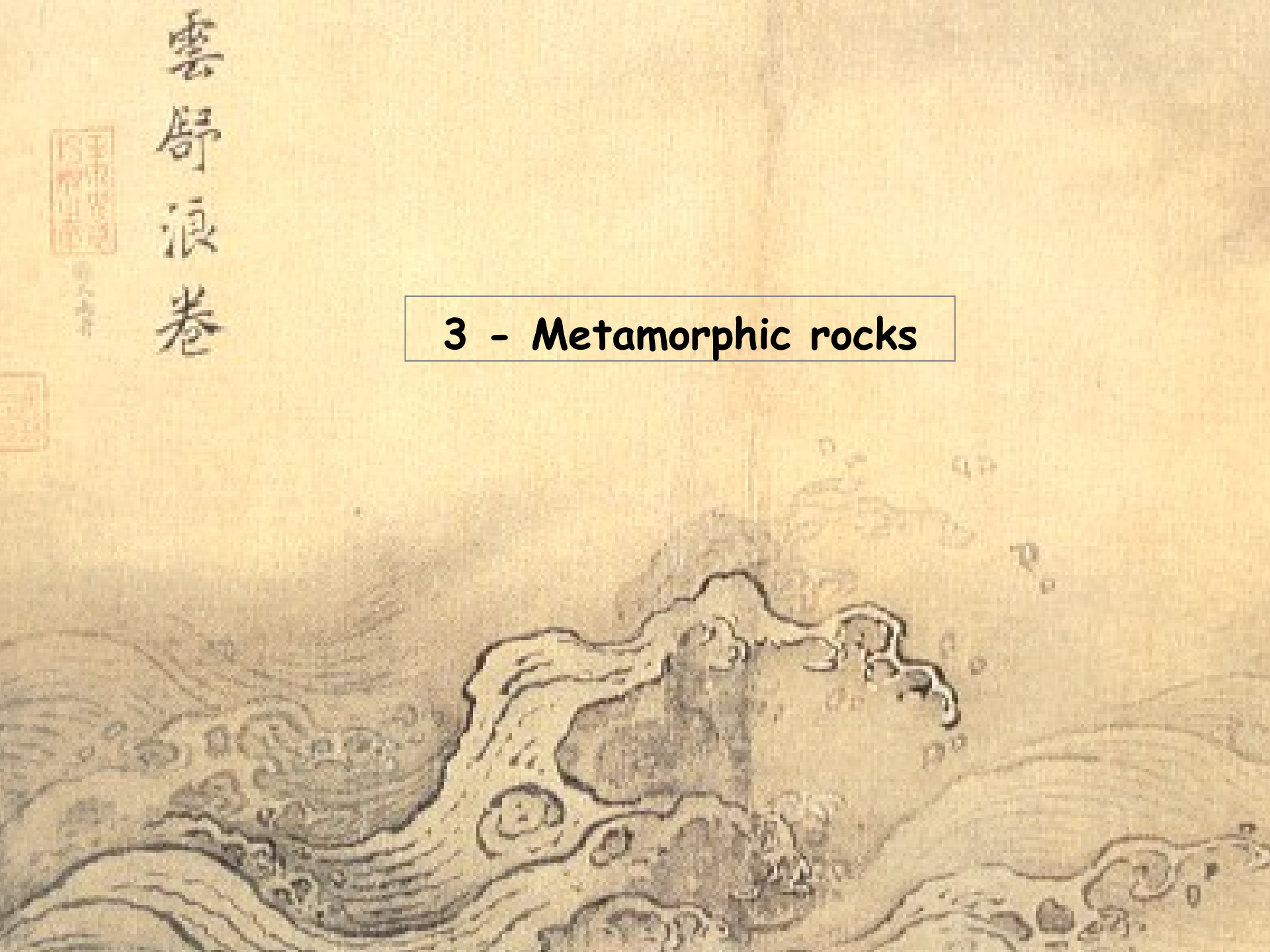


# 2 - Magmatic rocks : Volcanic rocks

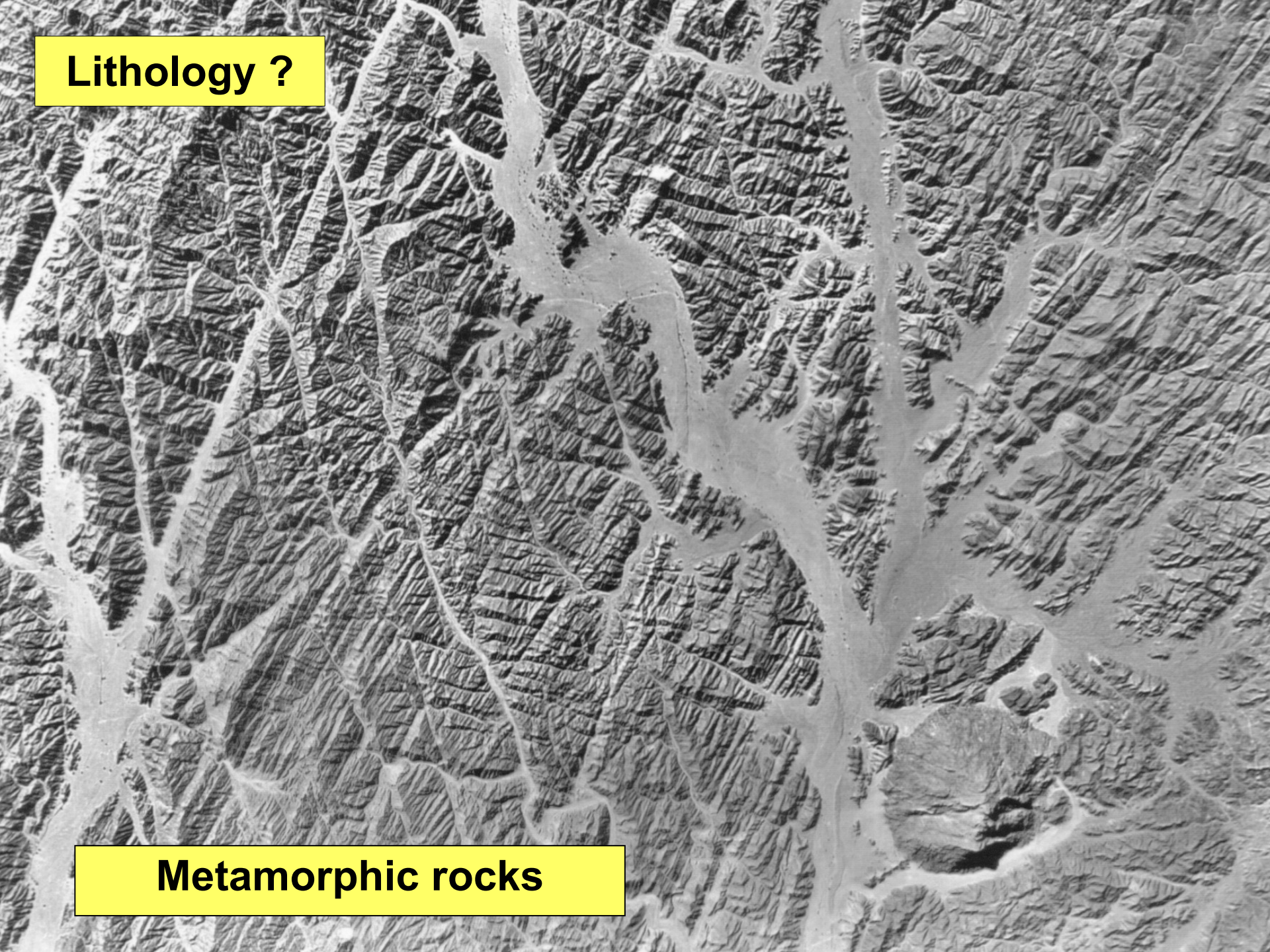
**Amphibolite**


Ophiolites

# 3 - Metamorphic rocks



**Metamorphic rocks :**
**Schists - Slates**


Lithology ?
Metamorphic rocks

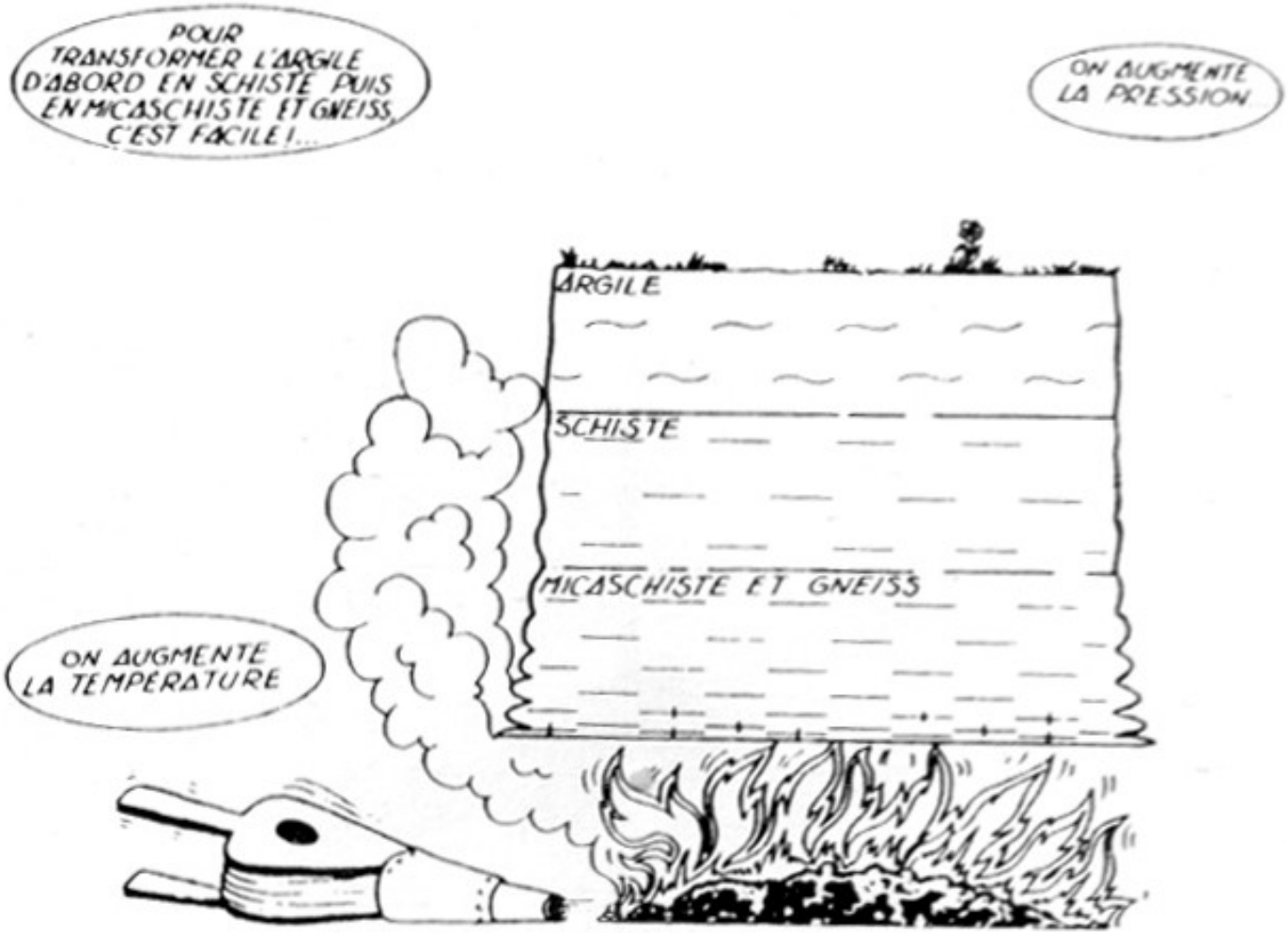
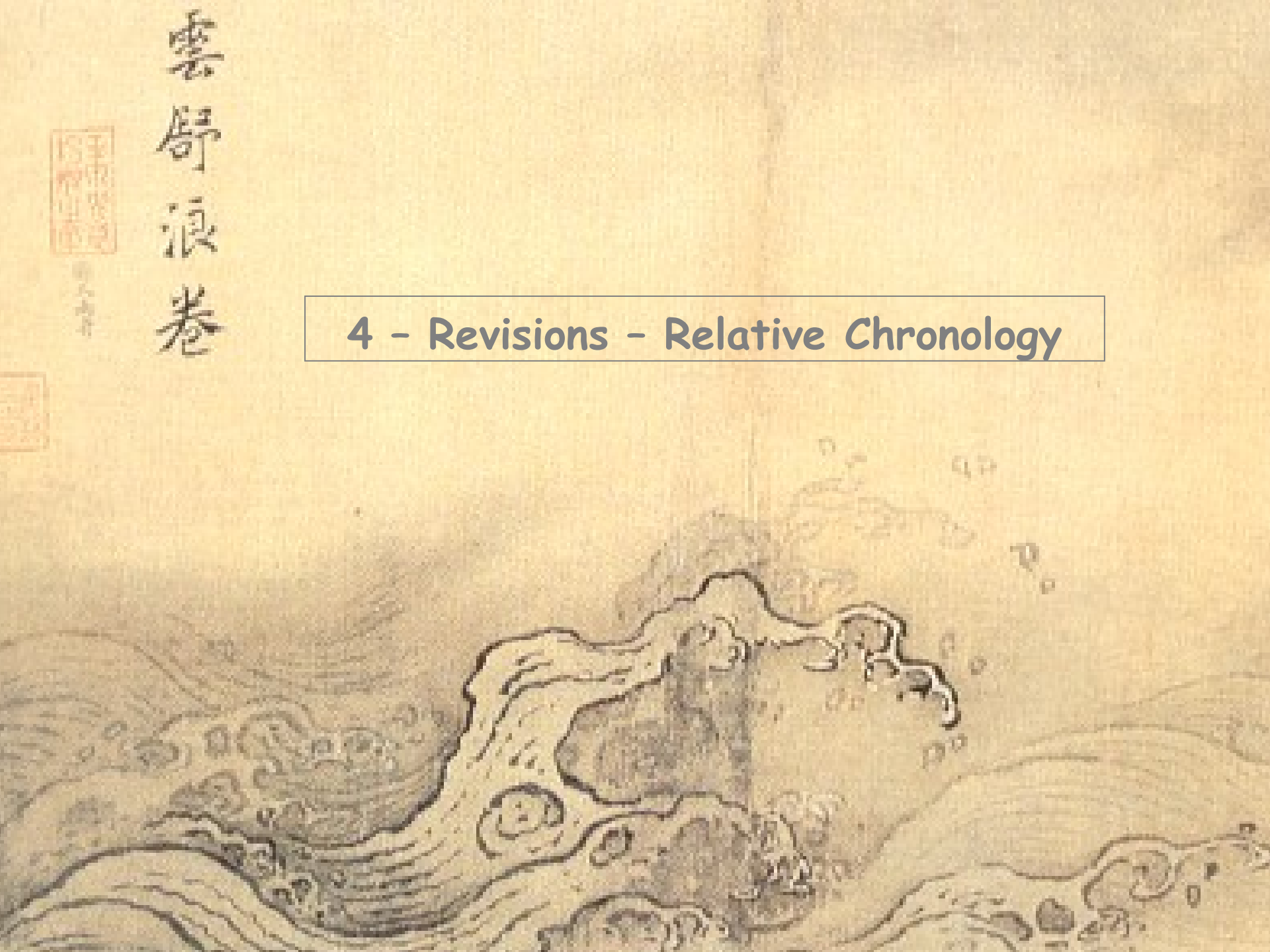



*Figure 7 - Le métamorphisme*

# 4 – Revisions – Relative Chronology



1- Lithology,
2- Structure,
3- Geological geomorpholo gical history,
4- Humain implications

# Quelques clefs pour la photo-interprétation:

- **Fréquence du réseau hydrographique:** [Forte fréquence: roche imperméable / Faible fréquence: roche perméable]; [Distance crête/talweg: faible: R. meuble; forte distance: roche dure].
- **Dureté des roches:** [Roche dure: en relief / roche tendre: dans les dépressions].
- **Homogénéité du relief:** Roche homogène: unique / inhomogénéité: plusieurs roches en présence [Allure de la SES: horizontale, plane, gradient…].
- **Allure de l'escarpement:** aspect festonné: grès/granite; aspect anguleux: carbonates…
- **Pente des versants:** versant convexo-concave: roche tendre; versant réglés ou de richter: nappé par des colluvions; versant à gradin: alternance de roche dure et tendre; escarpement: roche dure…
- **« Lignes de couleurs différentes et tâches dans les champs »:** stratification des roches sédimentaires / Roches plutoniques (massive sans stratification, absence de chevron…); Roches volcaniques: sombre, en langue ou mesa, présence de cône ou de dykes; Roches métamorphiques: débit, foliation ou schistosité.
- **Contexte géographique et géologique:** ex. conglomérats (glacis frontal devant une chaîne de montagne).
- **Difficulté de travailler sur textures et structures des roches**

| Rock types | Rock names | Drainage Frequency High +++, low --- | Slope Climate temperate | Potentiel érosif | Erosion Vitesse - time | Outcropping Color To be determined precisely | Texture Rugosity +++ to --- | Structure |
|---|---|---|---|---|---|---|---|---|
| Sedimentary Rocks | Clays and marls | +++ | --- | | | Light to dark | --- | |
| " | Sand | --- | --(-) | | | light | -- | |
| " | Sandstone | + | +++ | | | light | - | |
| " | Limestone | + | ++(+) | | | light | ++ | |
| Plutonic Rocks | Granite | ++ | ++ | | | Pink/blue/ grey | - to + | |
| Volcanic Rocks | Basalt | ++ | ++ | | | dark | -(-) | |
| Volcanic Rocks | cinerites | -- | -- | | | dark | --(-) | |
| Metamorphic rocks | Schists (origin Clays and marls) | ++ | -(-) | | | dark | -- | |
| " | Quartzite origin sandstone | +++ | ++ | | | white | + | |
| " | Marble origin limestone | +++ | ++ | | | White/ red | + | |
| " | Gneiss oriented | +++ | ++ | | | Blue to whitish | +(+) | |

Fonction of fracturation, foliation, matric, cement, climat (glaciaire, tempéré, tropical, équatorial) ,

f (erosion: mechanical desagregation and weathering), f(time of processes),

# Conclusions

## I - Methodological conclusions:

- Photointerpretation without stereoscope brings geological information;
- Photointerpretation under a stereoscope brings much detailed informations.

## II - Thematic conclusions :

- Find the outcropping lithologies and their geological structures is rather easy as it obeys to basic morphostructural keys.
- It is more complex in old reactivated areas such as in metamorphic basements and in volcanic environmment where the morphology is rejuvenated at each eruptions.
- Field work is anyway compulsory to confirm photointerpretations… This methdology save time and money…

# Bibliographic References


- Miller et Miller: Photogeology, Mc Graw-Hill Ed., 768p.
- Scanvic J.Y., 1989: Manuels et Méthodes de Télédétection, Coll. BRGM.
- Tricart J. et Cailleux A., 1961. Traité de géomorphologie….