



università di torino  
centro interdipartimentale sui rischi naturali in ambiente montano e collinare



## Part 2 of the lecture

1. Geodiversity and cultural landscapes: theoretical concepts and specificities of case studies
2. **Geoheritage: research and valorization projects in a changing landscape**
3. Examples of 3D modeling of cultural landscapes
4. Spreading Geodiversity awareness in protected areas through Multimedia

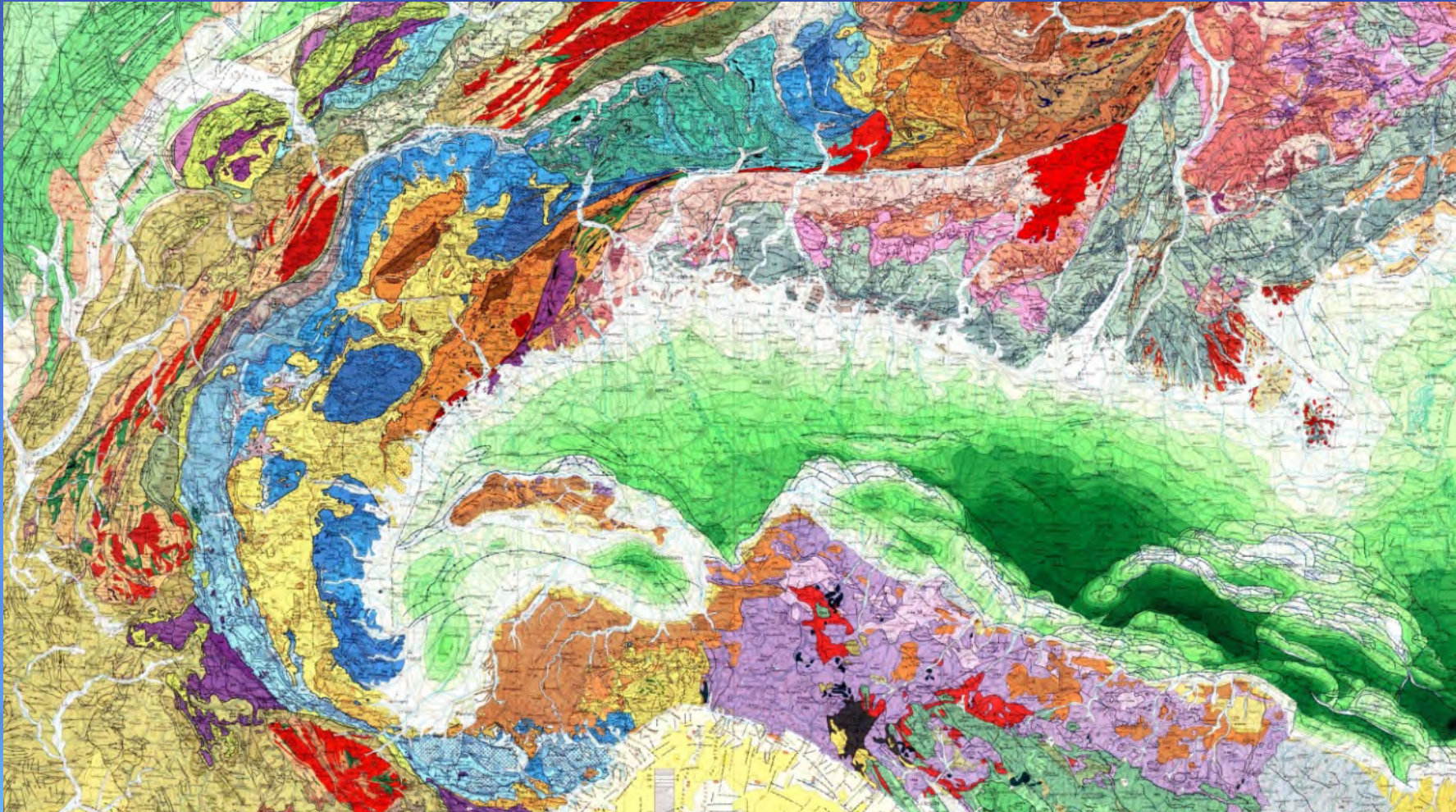
*Cultural Landscapes*

**Geodiversity**

**3D models**

**Multimedia  
parks @**

# the Alps, the Hills, the Po Plain...



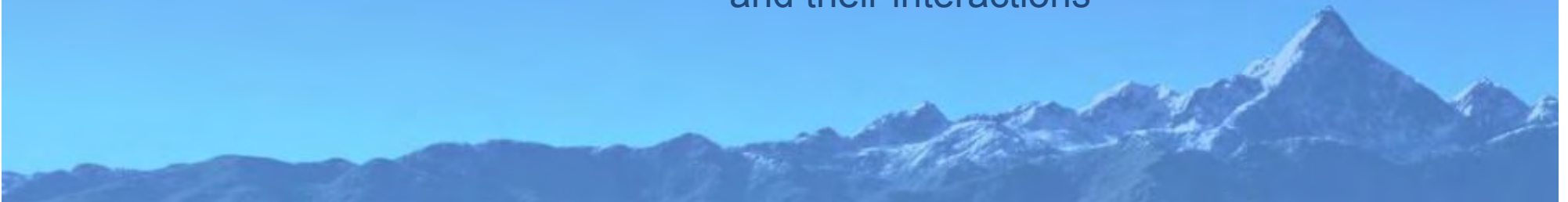
## Geodiversity

of litological units, structural characters, paleo environments

## *Target: the Alps...*



*... a set of landscapes expressing their identity...*  
whose character depends from natural and human factors,  
and their interactions



# The cultural landscape of the Alps...

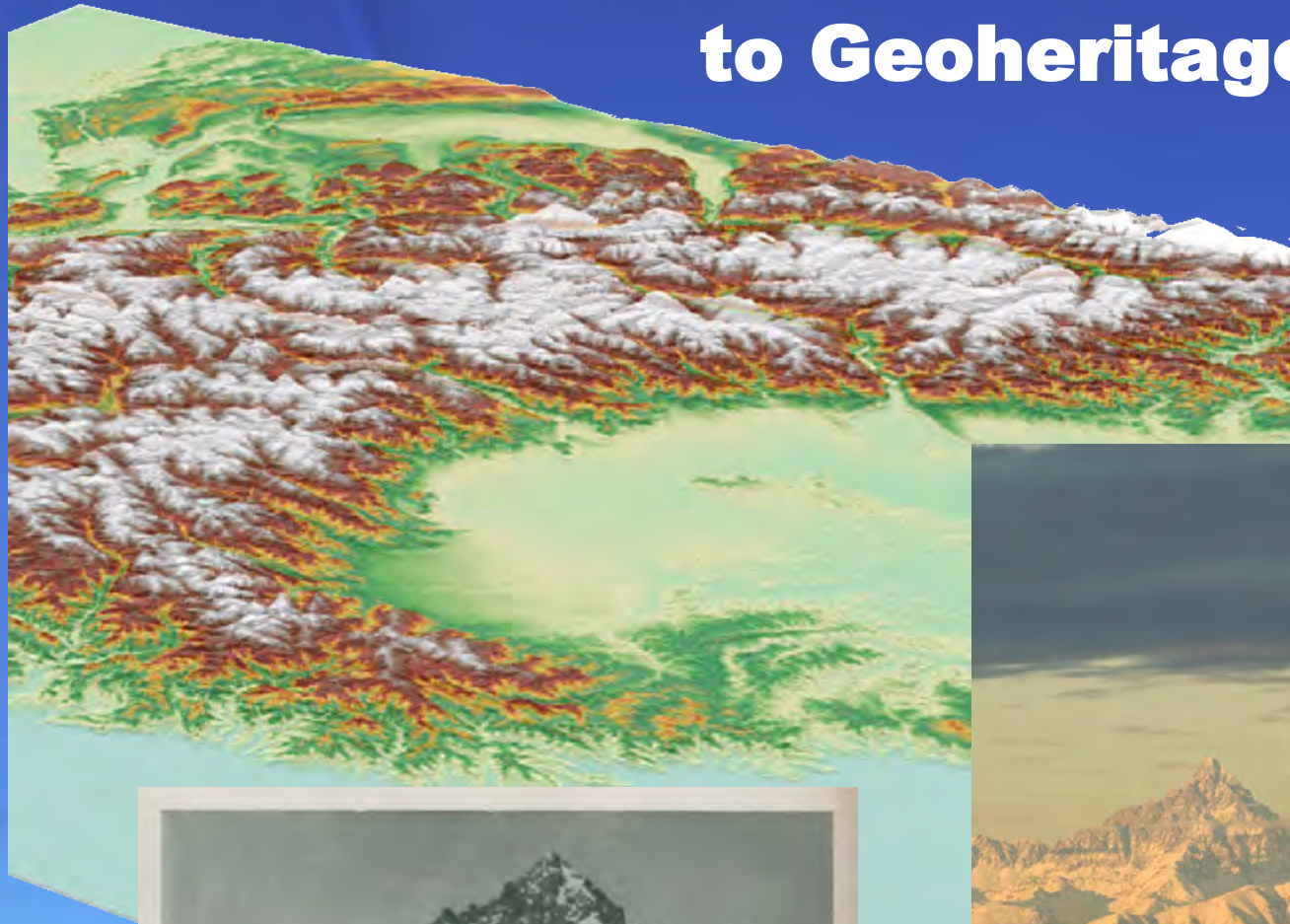


*...an ensemble of values...*  
based on geological and geomorphological  
elements, values increased through the History,  
by means of human actions

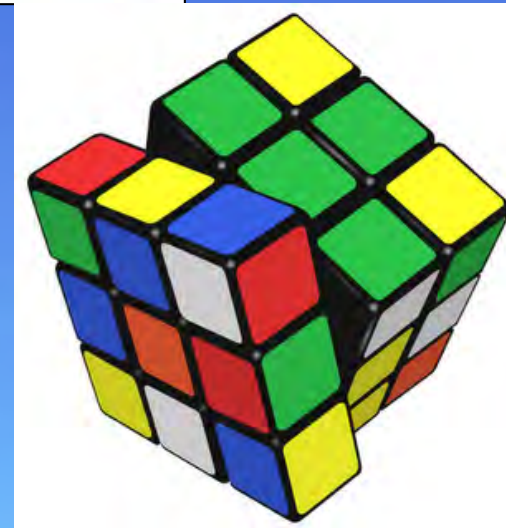
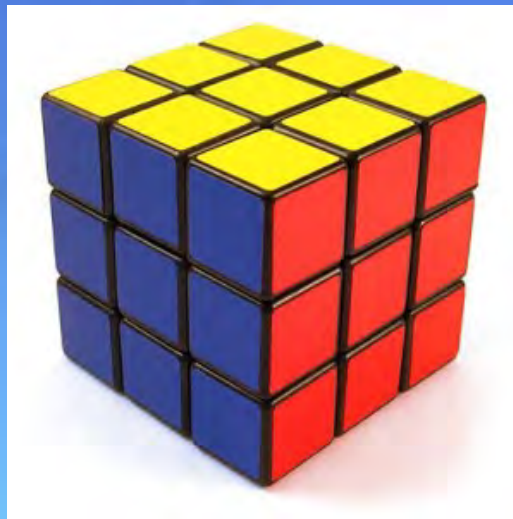
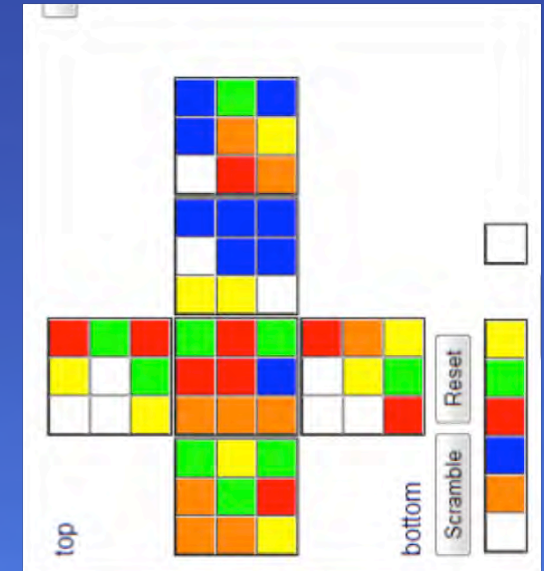
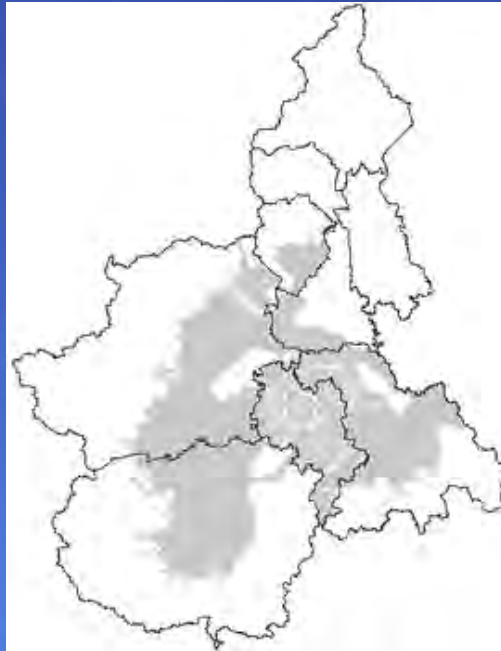
*Western  
Alps and  
Piemonte:*

**From Geodiversity**

**to Geoheritage**



*The  
idea...*



*... of Rubik!*



**PROGEO**  
PIEMONTE

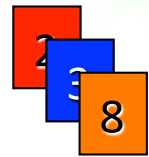
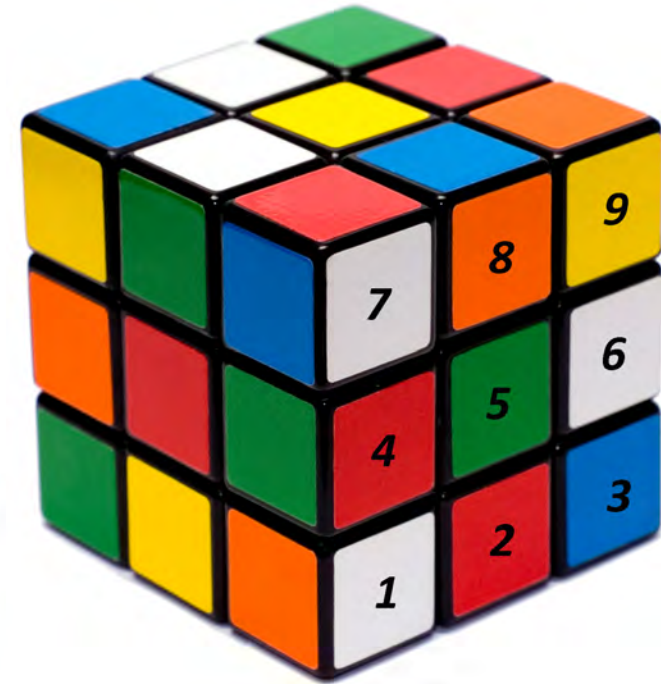
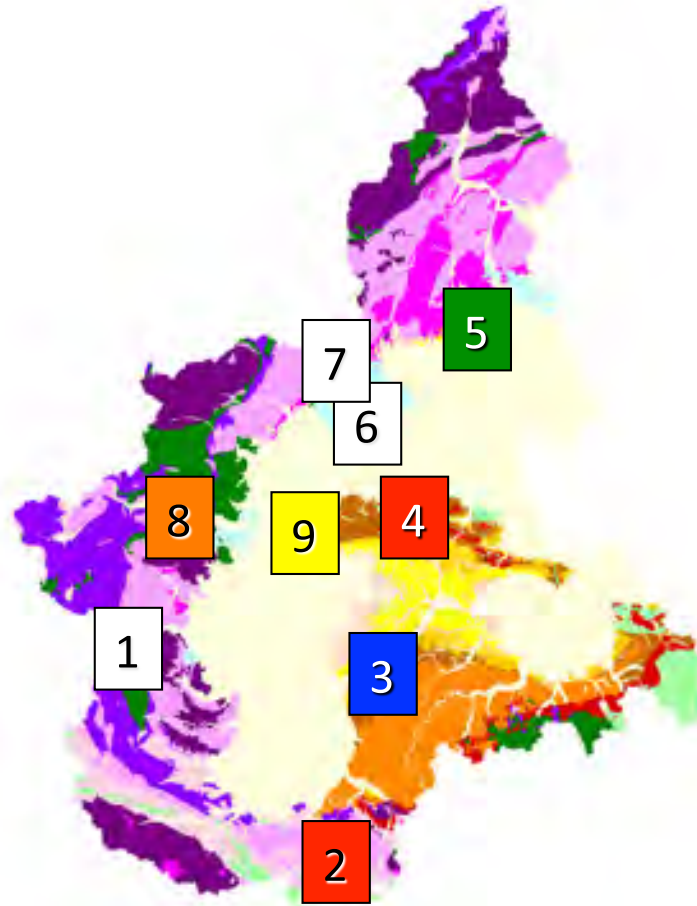
# A multidisciplinary research project for developing a PROactive management of GEOlogical heritage in the PIEMONTE region

*Marco Giardino and the PROGEO-Piemonte research group*

*Dipartimento di Scienze della Terra  
Università degli Studi di Torino*

[marco.giardino@unito.it](mailto:marco.giardino@unito.it)

**PROGEO**  
PIEMONTE



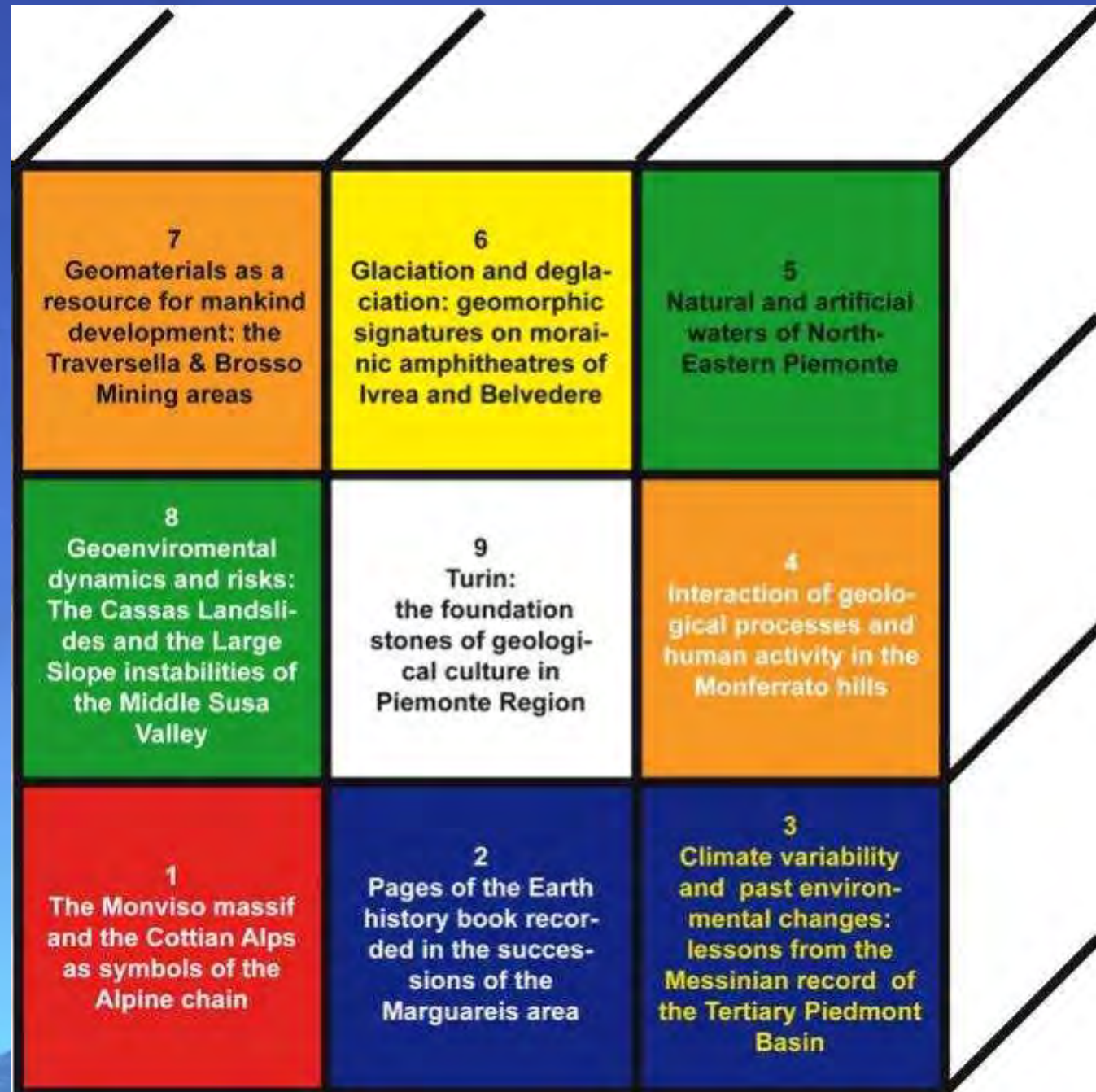
**9 GEOTHEMATIC AREAS**



**4 INTERDISCIPLINARY THEMES**



# The regional geothematic areas

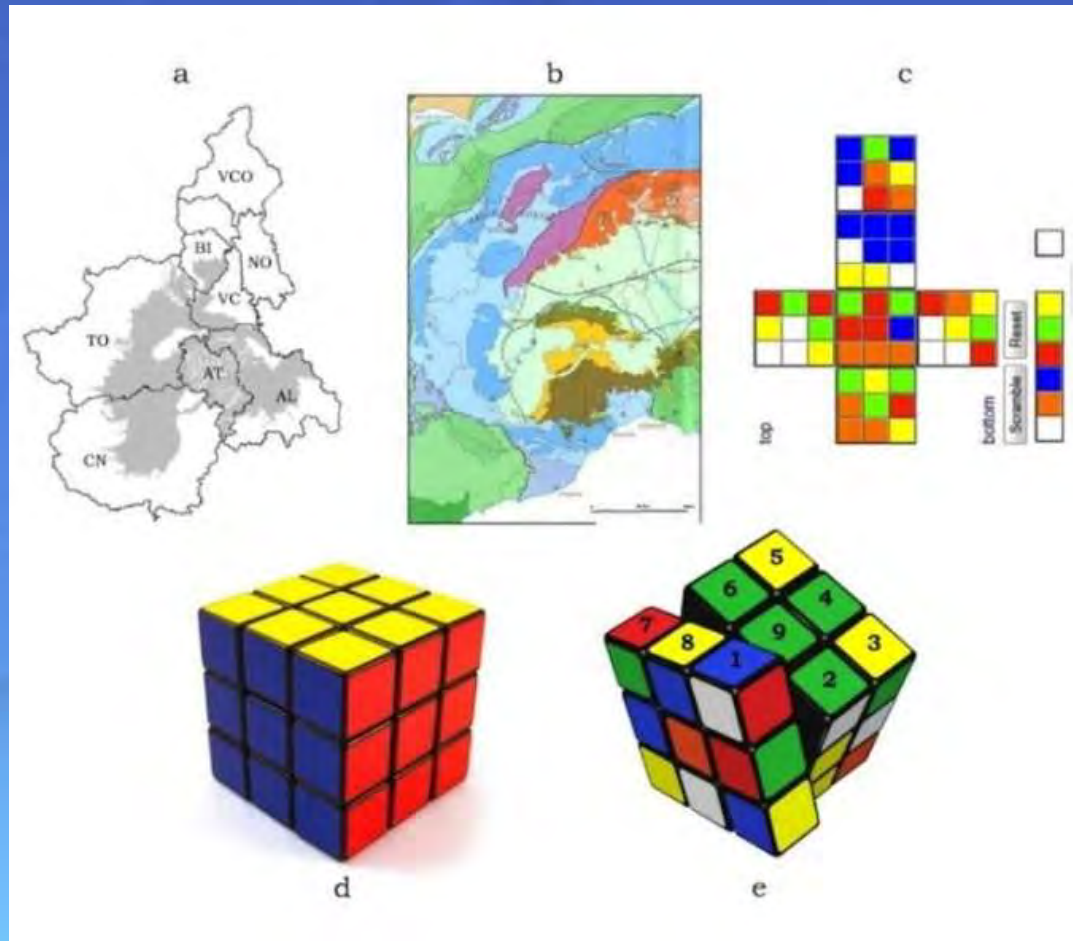


# Methodology

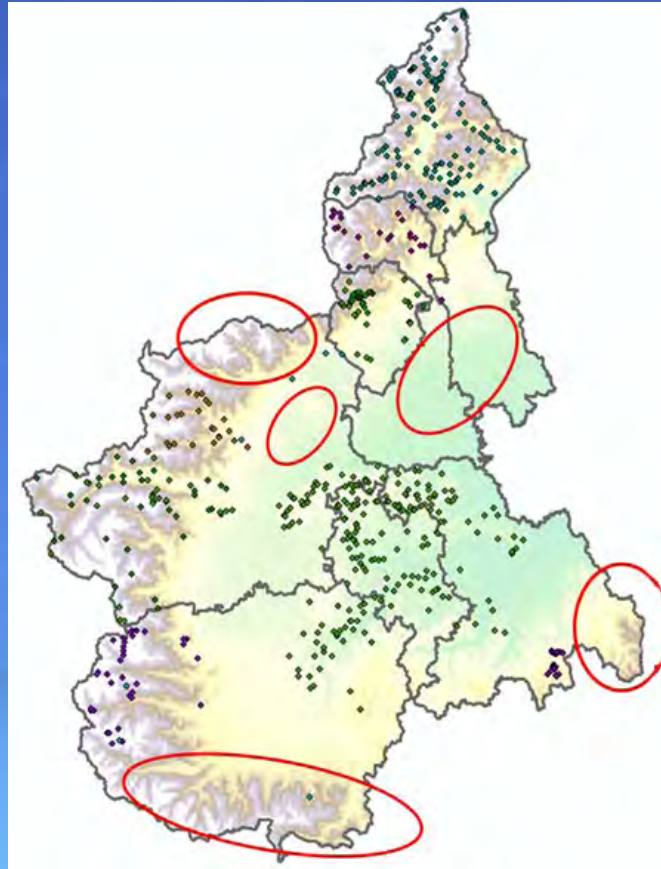
Selection and re-assembly of territorial and geological components of Geodiversity

## Objectives

- Developing targeted activities for promotion and management of geoheritage (geodiffusion and geoconservation)
- Maintaining a balance between geoheritage protection and the need of local communities (geo-sustainable economy)



# Geodiversity of the territory...



# ... heterogeneity of geosites







A TYPOLOGY of INTERPRETED GEOLOGICAL SITE



- 1 ideal commercial site
- 2 ideal tourist site
- 3 typical interpreted site
- 4 ideal school use site
- 5 ideal university use site
- 6 pure research site

Each “geothematic area” is characterized by high potential for **scientific studies**, **enhancement of public understanding of science**, **recreational activities** and **new projects for economic support to local communities**.

### Geological contents

<b>Projects</b>	<p><b>Geomateriali come risorsa per lo sviluppo dell'umanità: i siti di Traversella e Brosso</b></p> 	<p>Sviluppo tecnologico, industriale e culturale dei siti di Traversella e Brosso</p> <p style="text-align: right;"><b>7</b></p>	<p><b>Glaciazione e deglaciazione: geomorfologia dell'AMI e del Belvedere</b></p> 	<p>Anfiteatro Morenico di Ivrea (AMI) e apparato morenico del Belvedere: inquadramento sotto i profili cronologico, paleoclimatico, giacimentologico</p> <p style="text-align: right;"><b>6</b></p>	<p><b>Acque antropiche e naturali del Piemonte NE</b></p> 	<p>Evoluzione del paesaggio e variazioni climatiche durante il Quaternario, le acque come agente modellante del paesaggio e dell'uso antropico del territorio</p> <p style="text-align: right;"><b>5</b></p>
	<p>Museo Regionale di Scienze Naturali</p> <p style="text-align: right;"><b>7</b></p>	<p>Potenziamento delle collezioni e preparazione di materiale didattico e divulgativo per musei locali e regionali</p> <p style="text-align: right;"><b>7</b></p>	<p>Attività scientifiche, didattiche e di valorizzazione in collaborazione con i principali enti locali, tra cui parchi e comunità montane e collinari</p> <p style="text-align: right;"><b>6</b></p>	<p>Attività divulgative per studenti, insegnanti e grande pubblico; proposta di geoparco dell'AMI</p> <p style="text-align: right;"><b>6</b></p>	<p>Schede di valutazione di geositi e loro inserimento nel database regionale. Modelli geomorfologici 3D</p> <p style="text-align: right;"><b>5</b></p>	<p>Proposte di collaborazione con Riserva naturale orientata Le baragge, Parco fluviale Lame del Sesia, Riserva naturale Sacro Monte d'Orta</p> <p style="text-align: right;"><b>5</b></p>
	<p><b>Dinamica e rischi ge ambientali: l'instabilità di versante della Media Val di Susa</b></p> 	<p>Gli stadi evolutivi quaternari in Val Susa e le evidenze di frane storiche e preistoriche</p> <p style="text-align: right;"><b>8</b></p>	<p><b>Torino città di pietra</b></p> 	<p>Illustrare l'importanza culturale, scientifica ed architettonica delle numerose pietre ornamentali storiche e contemporanee della città di Torino</p> <p style="text-align: right;"><b>9</b></p>	<p><b>Interazione tra processi geologici e attività antropiche nelle Colline del Monferrato</b></p> 	<p>Interazione tra tettonica ed evoluzione della collina. Studio delle risorse naturali (acqua, geomorfologia e clima)</p> <p style="text-align: right;"><b>4</b></p>
	<p>Progetto Interreg ALCOTRA "Geoparco delle Alpi Cozie", itinerari didattici nel Parco Naturale Gran Bosco di Salbertrand</p> <p style="text-align: right;"><b>8</b></p>	<p>Contributo al Progetto Strategico Interreg ALCOTRA "RiskNat" (Reg. Piemonte e Prov. di Torino), realizzazione di itinerari didattici nella zona</p> <p style="text-align: right;"><b>8</b></p>	<p>Corso breve rivolto agli insegnanti di Scienze della scuola di II grado, Geoitalia 2011 (SC5 - Le Alpi in città: un percorso tra le vie, le piazze e i monumenti di Torino); MRSN</p> <p style="text-align: right;"><b>9</b></p>	<p>Diffusione delle conoscenze su pietre ornamentali per operatori del restauro e del turismo (Museo delle Antichità Egizie, Museo Torino, Comitato glaciologico italiano, CAI)</p> <p style="text-align: right;"><b>9</b></p>	<p>Progetto per la mitigazione del rischio geomorfologico del territorio (Regione Piemonte, Comunità Collinare Alto Astigiano)</p> <p style="text-align: right;"><b>4</b></p>	<p>Itinerario geologico (Regione Piemonte, Comunità Collinare Alto Astigiano)</p> <p style="text-align: right;"><b>4</b></p>
	<p><b>Il Monviso e le Alpi Cozie: simboli della catena alpina</b></p> 	<p>I resti preservati dell'antico oceano. La nascita e lo sviluppo di una catena orogenica. La genesi di importanti mineralizzazioni</p> <p style="text-align: right;"><b>1</b></p>	<p><b>Pagine del libro di Storia della Terra: il Marguareis e il Colle di Tenda</b></p> 	<p>Le fasi evolutive del margine europeo della Tetide Alpina: apertura dell'oceano e formazione della catena Alpina, tra Marguareis e Col di Tenda</p> <p style="text-align: right;"><b>2</b></p>	<p><b>Paleoclima e paleoambiente: lezioni dal BTP</b></p> 	<p>Dalla Crisi di Salinità del Messiniano una finestra sulle future variazioni ambientali e climatiche</p> <p style="text-align: right;"><b>3</b></p>
	<p>Progetto Interreg ALCOTRA "Geoparco delle Alpi Cozie" EcoMuseo Minerario "Scopriminiera", Val Germanasca, Prali</p> <p style="text-align: right;"><b>1</b></p>	<p>Museo ScopriALPI</p> <p style="text-align: right;"><b>1</b></p>	<p>Parco delle Alpi Marittime, Parco dell'Alta Valle Pesio e Tanaro, Associazione geoturistica GEO d'OC</p> <p style="text-align: right;"><b>2</b></p>	<p>Itinerari geoturistici all'interno dei parchi delle Alpi Marittime e dell'Alta Valle Pesio e Tanaro</p> <p style="text-align: right;"><b>2</b></p>	<p>Geosito stratigrafico di Verrua Savoia, Cementi Vittoria S.p.A., Parchi Fluviali del Po</p> <p style="text-align: right;"><b>3</b></p>	<p>Proposte di nuovi percorsi geotematici (es. Pollenzo) per descrivere la successione di eventi e di ambienti</p> <p style="text-align: right;"><b>3</b></p>

**Raising the geological heritage**

**New planned activities, territorial benefits**

# 4 INTERDISCIPLINARY Themes

**Themes A** - Geomatics applications for evaluation and management of Piemonte geoheritage

*Computer Sciences for the analysis of the territory*

**Themes B**- Visual representation of geological environment and processes

*Innovative multimedia products for Earth Sciences*

**Themes C** - Geodiversity action plans for dissemination activities

*How to spread geological awareness?*

**Themes D** - Tool integrated management of a geosite: application of TIQ (Territorial Integrated Quality)

*Economical evaluation of the geoheritage*

**LIFE QUALITY**

- Environment
- Society
- Economy

**SUSTAINABLE  
DEVELOPMENT**

- Environmental Protection
- Safe Job Places
- Social Responsibility



**Integrated  
Territorial Policy**



**Plans, Programs, Actions, Targets**

**Sesia-Val Grande Geopark**

**“ScopriAlpi”**



SEZIA VAL GRANDE  
**GEO PARK**













SEZIA VAL GRANDE  
GEOPARK

***Promoting Earth Heritage***

***Sustaining Local Communities***

# Sesia-Val Grande Unesco Geopark

A success  
local to global:  
scientific,  
organizzational,  
territorial





Erasmus+

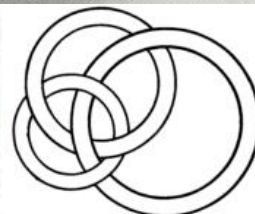


PROVINCIA  
VERBANO CUSIO OSSOLA

# International Partnerships for Geoparks



SEZIA VAL GRANDE  
GEOPARK



VAALEANKIO



istituto  
L. COBIANCHI

adolescenti, studenti, cittadini



**Research**



**Technologies**



**Culture**

**Our Project: Scientific contents**  
*I contenuti scientifici del nostro progetto*  
**Tieteellinen sisältö Projektimme**



**Nature**

**GEO DIVERSITY**  
 The natural range of geological, geomorphological and soil features of a landscape  
 Gray, 2004  
 Zwolinsky, 2004

**GEOHERITAGE**  
 The range of sites or areas of geological features with significant scientific, educational, cultural, or esthetic value  
 O'Halloran et al. 1994  
 Declaration of the Rights of the Memory of the Earth, Digne 2001



**Infrastructure**

**GEO SITE**  
 Earth surface processes and landforms telling Earth's history  
 Panizza e Piacente, 2008  
 Serrano e Ruiz-Flano, 2007

**GEO CONSERVATION**  
 The conservation of our non-living natural environment  
 European Landscape Convention, Florence 20/10/2000



**Stakeholders**

# GEOPARKS



Research



Nature

## GEODIVERSITY

The natural range of geological, geomorphological and soil features of a landscape

Gray, 2004

Zwolinsky, 2004

## GEOHERITAGE

The range of sites or areas of geological features with significant scientific, educational, cultural, or esthetic value

O'Halloran et al. 1994

Declaration of the Rights of the Memory of the Earth, Digne 2001



Infrastructure



Technologies

## GEOSITE

Earth surface processes and landforms telling Earth's history

Panizza e Piacente, 2008

Serrano e Ruiz-Flano, 2007

## GEOCONSERVATION

The conservation of our non-living natural environment

European Landscape Convention, Florence 20/10/2000



Culture

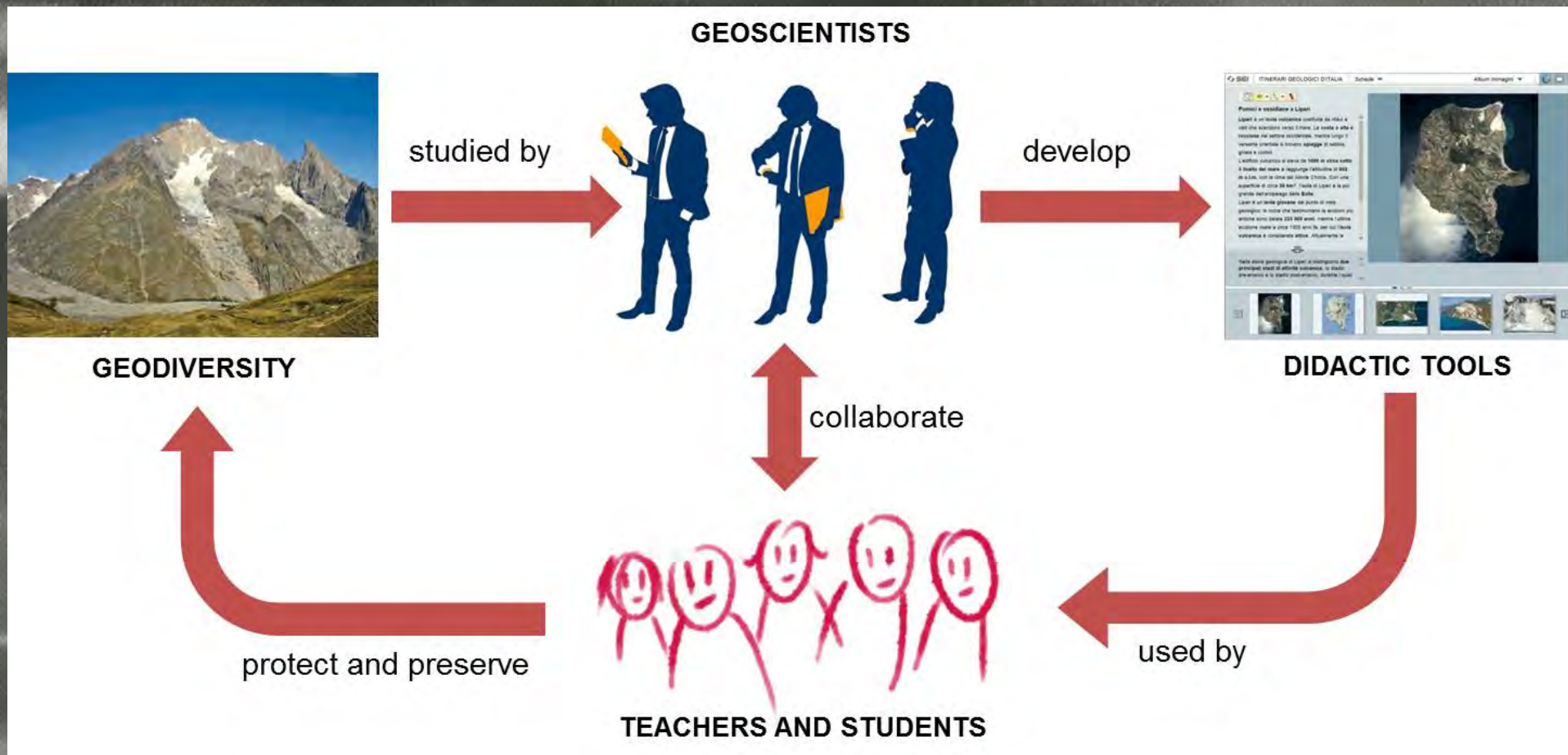
# EDUCATION



Stakeholders



# Our conceptual framework





**GEODIVERSITY**

studied by



develop



**DIDACTIC TOOLS**

collaborate



**TEACHERS AND STUDENTS**

protect and preserve



used by



**...speciphically addressed to Geoparks**

# Our International Short-term student exchanges





## Our Geoparks: Finnish heritage of the Ice Age

heritage of the  
**iceage**



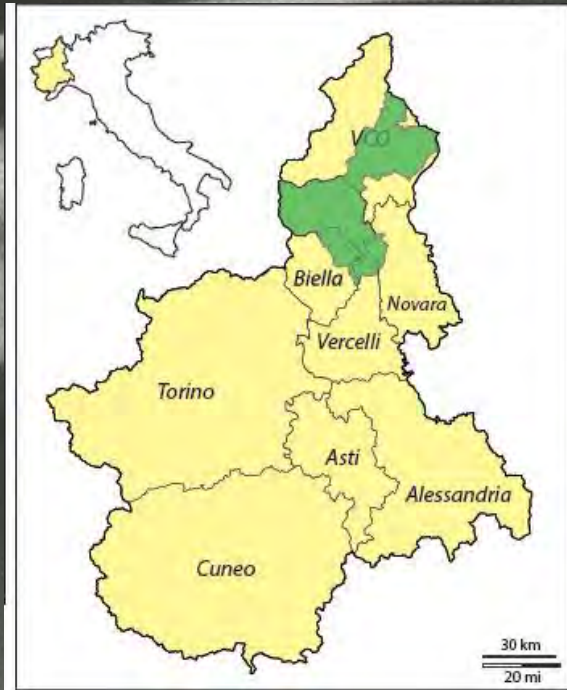


**Geopark's area:** 1 320 km<sup>2</sup>  
**Elevation:** 11 to 194 m asl  
**Municipalities:** 3  
**Population:** 20 000  
**Main theme:** Heritage of the Ice Age

**Year of recognition:**  
2010



**Alpine geodiversity and cultural heritage**



**Geopark's area:** 213 959 hectares

**Elevation:** 190 to 4 554 m asl

**Municipalities:** 85

**Population:** 152 813

**Year of recognition:**

**2013**

## SEZIA - VAL GRANDE GEOPARK

### LEGEND

- Geopark boundaries
- Val Grande National Park
- Sesia supervolcano area
- Alta Valsesia Natural Park
- Fenera Natural Park



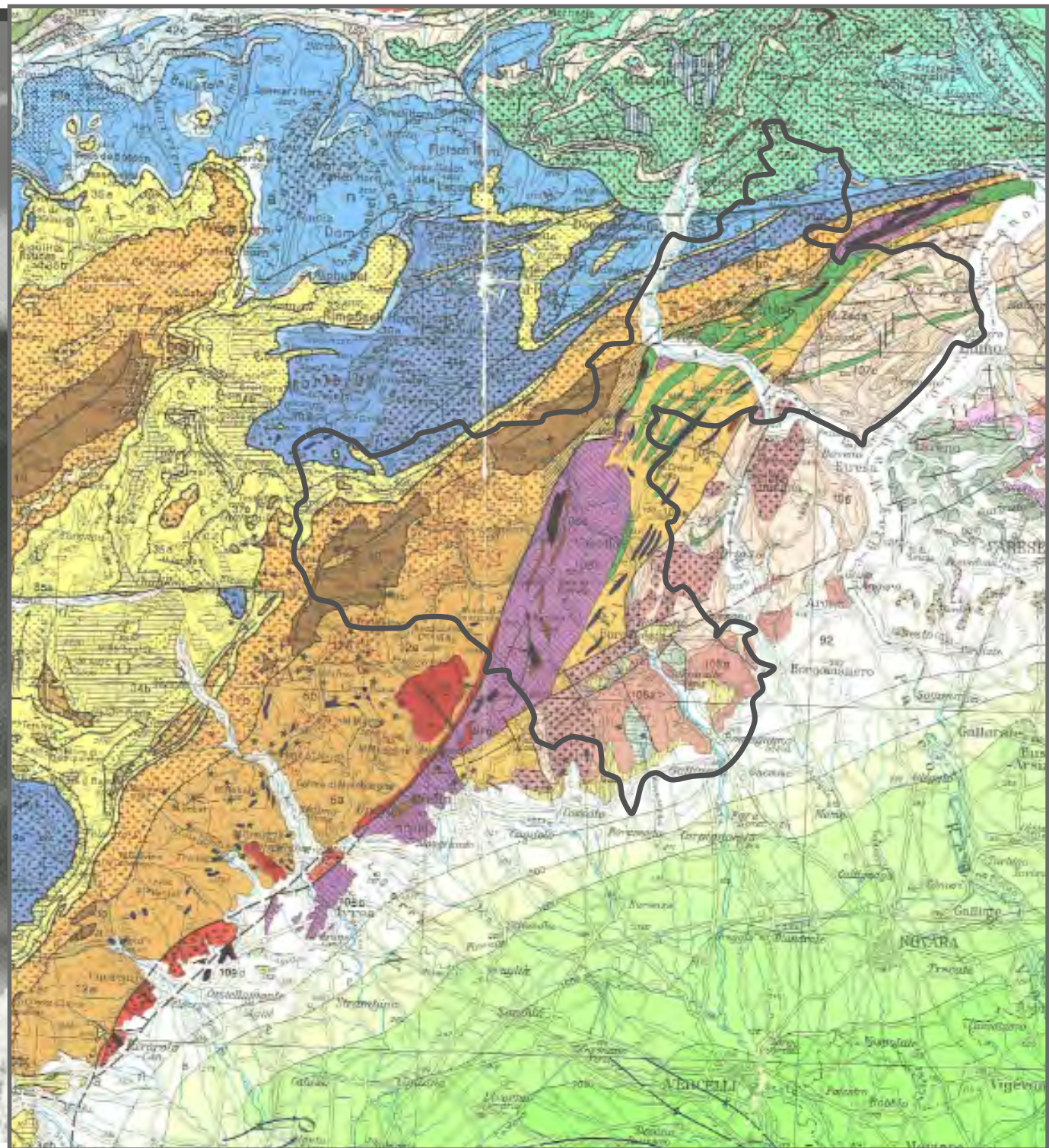
# An area rich of Earth Sciences contents

**Paleogeography:  
paleocontinents and  
oceans (a long  
history...)**

**Structural Geology:  
The major Alpine units  
and tectonic  
discontinuities**

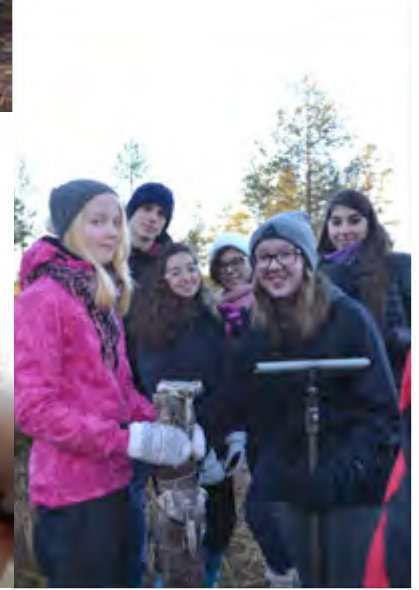
**Litology  
A large variety of rock  
types (...some valuable  
ornamental stones)**

**Geomorphology  
Environment,  
landforms, processes  
(some... pretty active!)**





**Our activities In Finland**  
*Le nostre attività in Finlandia*  
*Toimintamme Suomessa*



Our Home's secrets  
*I nostri segreti di casa*  
Kotiseutumme salaisuudet



**Meetings and social activities**  
*Riunioni e momenti conviviali*  
*Kokoukset ja muu yhdessäolo*



**We are the participants**  
*Noi, i partecipanti*  
**Me osallistumme projektiin**



**Global Change or Species Evolution?**  
*Cambiamenti globali o evoluzione della specie?*  
*Globaalit muutokset ja kehitys lajien?*



**Future Activities in Italy**  
*Attività future in Italia*  
*Tuleva toimintamme Italiassa*



**The Fondotoce area is formed by fluvial deposits.  
Toce and Strona River have been modelling it for 10k years.  
The Montorfano and Mottarone mounts are made of granitic bedrock  
modelled by glaciers during Pleistocene**



## Environmental and territorial changes in the last century





# BIODIVERSITY: FLORA



iris giallo



castagna d'acqua



mazzasorda maggiore



mazza d'oro



carici

# BIODIVERSITY: FAUNA



**luccio**



**carpa**



**scardola**



**pettirosso**



**cannaiola**



**rondine**



**zigolo**



Parco Veglia-Devero



Mozzio

Pian Cavallo di Oggebbio



Possaccio



I.I.S. L. Cobianchi



Parco Lagoni di Mercurago

PARCO VEG

Ticino

Verbano-Cusio-Ossola

Riserva Naturale Fondotoce

I.I.S. L. COBIANCHI  
VERBANIA INTRA

**Pollinators as  
bioindicators of  
Climate Change**

# Nests



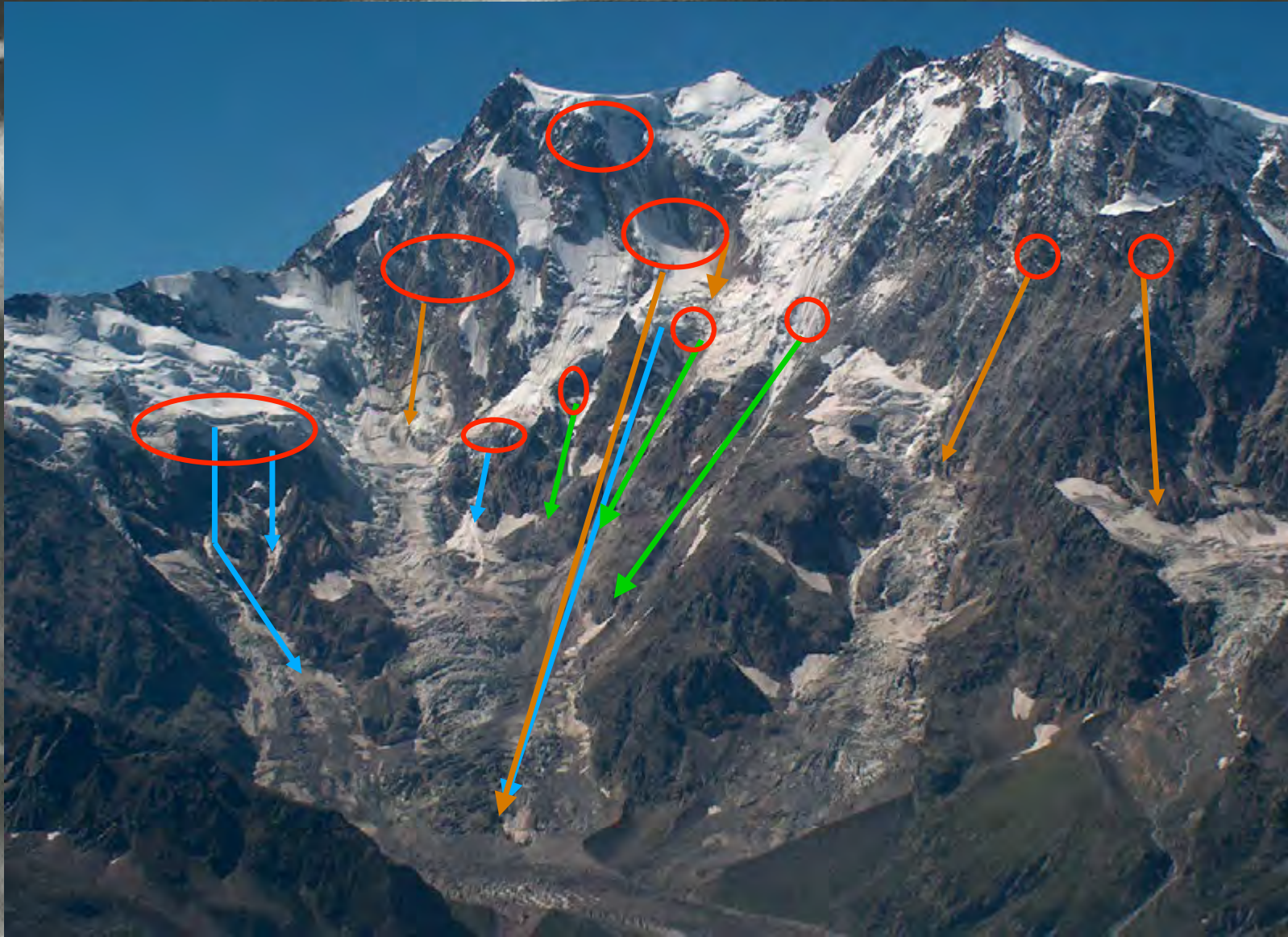


**Looking for the *Chalicodoma sculpturalis* at the Fondo Toce Natural Reserve**

# Environmental changes in the “himalayana” NE face of Monte Rosa



# Climate change and slope instabilities



○ Detachment zone

→ Rock fall

→ Debris flow

→ Ice avalanche

Glacier

Slope instabilities

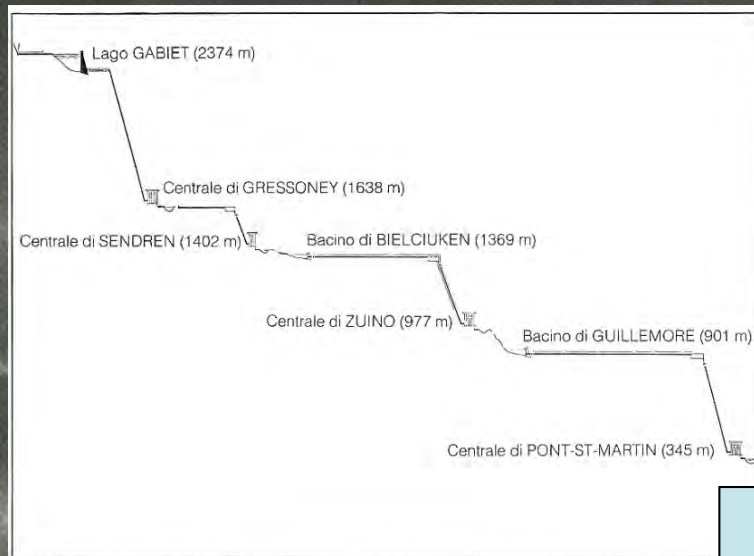
Synthesis

# Ghiacciaio di Indren



## Climate change and water resources

....from Monte Rosa glaciers...  
....to rice field of the Po plain...



*risaie vercellesi*





**Geoparks are the appropriate places for testing and practicing innovative educational strategies**



Students and teachers are involved in **research activities**, including **sampling** and **digital mapping**

## Parts 3-4 of the lecture

1. Geodiversity and cultural landscapes: theoretical concepts and specificities of case studies
2. Geoheritage: research and valorization projects in a changing landscape
3. Examples of 3D modeling of cultural landscapes
4. Spreading Geodiversity awareness in parks through Multimedia and Field trips

*Cultural Landscapes*

**Geodiversity**

**3D models**

**Multimedia  
parks @**

# Applications in the Sesia-Val Grande Geoparks

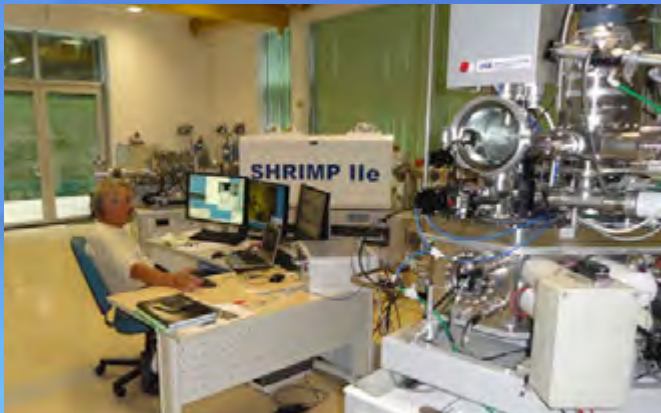


... To  
**GEOTOURISM**



... To **SCIENTIFIC  
DEBATES**

**AN  
INVITATION...**



... To **LABORATORY  
RESEARCH**

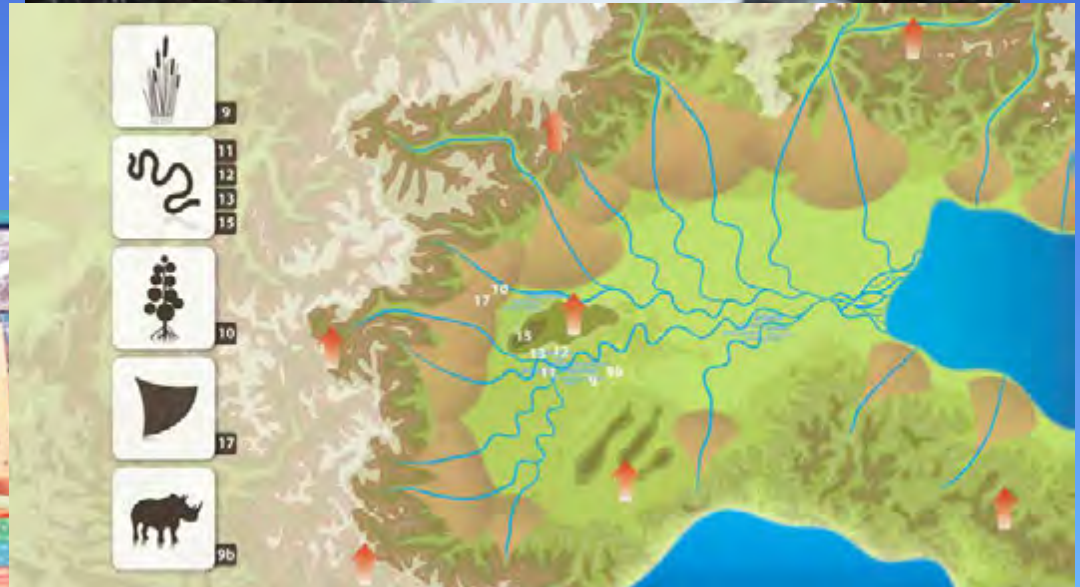


... To **EDUCATIONAL ACTIVITIES**



# European researcher's night ESOF 2010– Science in the Cities

# Virtual Reality animations



Didactic materials for science exhibits



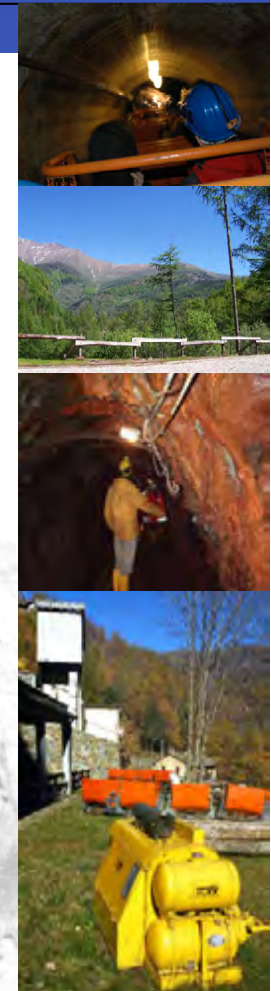


**Integrate Territorial Plan**  
 “P.I.T. Le Alte Valli.  
 La montagna fa sistema”



**ScopriAlpi**  
*DiscoverAlps*

**Geothematic  
 museum  
 on the geological  
 history of the Alps  
 (lithology,  
 stratigraphy,  
 metamorphism,  
 structure,  
 geomorphology)**



Comunità Montana  
 Valli Chisone e Germanasca



Cooperazione transfrontaliera - Coopération transfrontalière



communauté  
 de communes du

*Briançonnais*

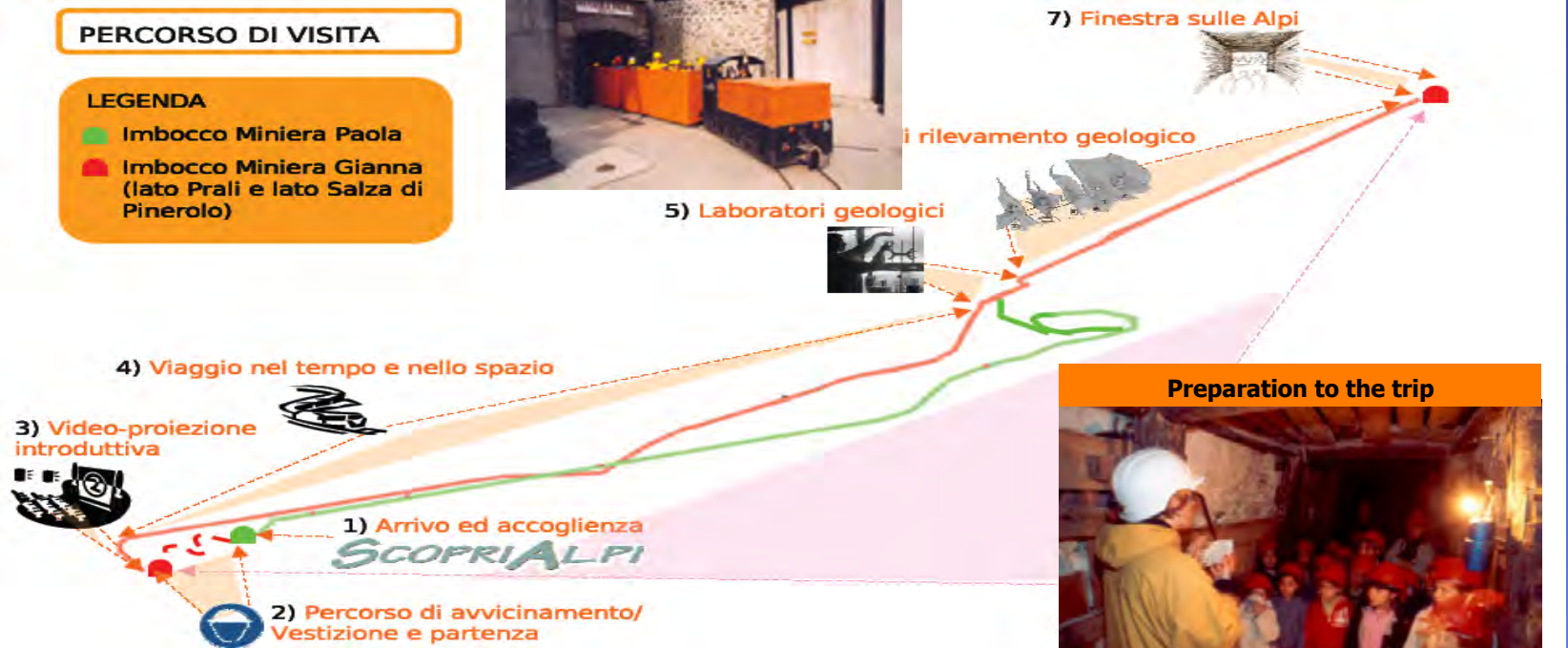
### Paola Mine (Scopriminiera)



### PERCORSO DI VISITA

#### LEGENDA

- Imbocco Miniera Paola
- Imbocco Miniera Gianna (lato Prali e lato Salza di Pinerolo)



### Preparation to the trip



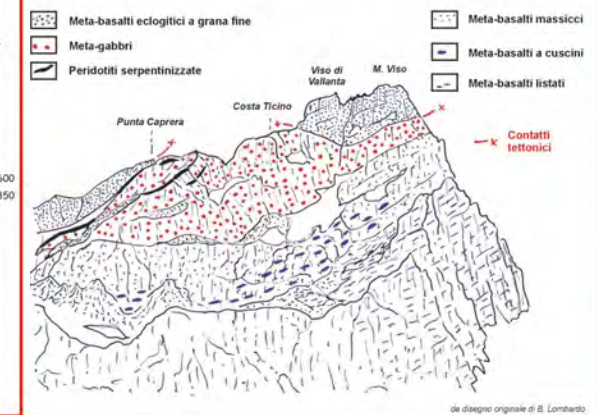
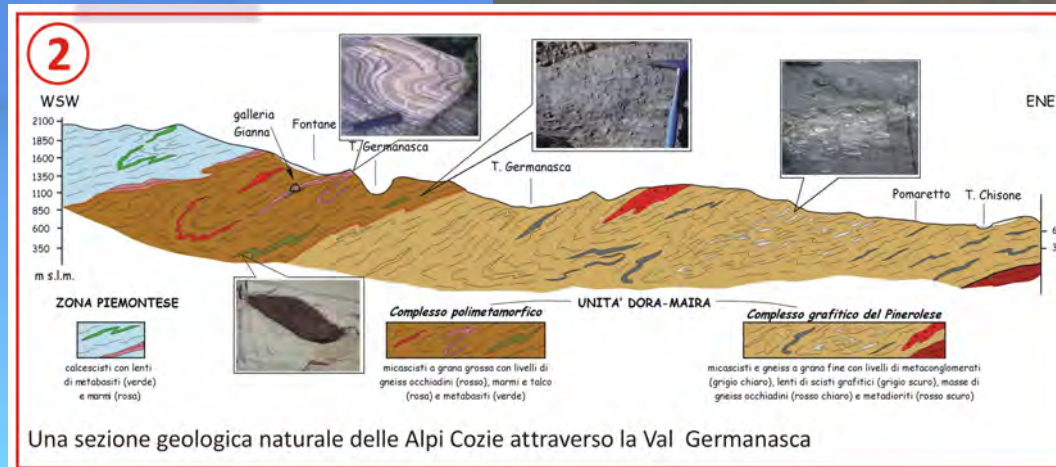
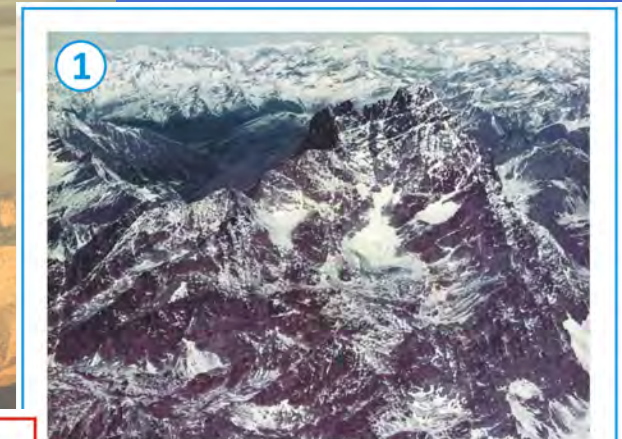
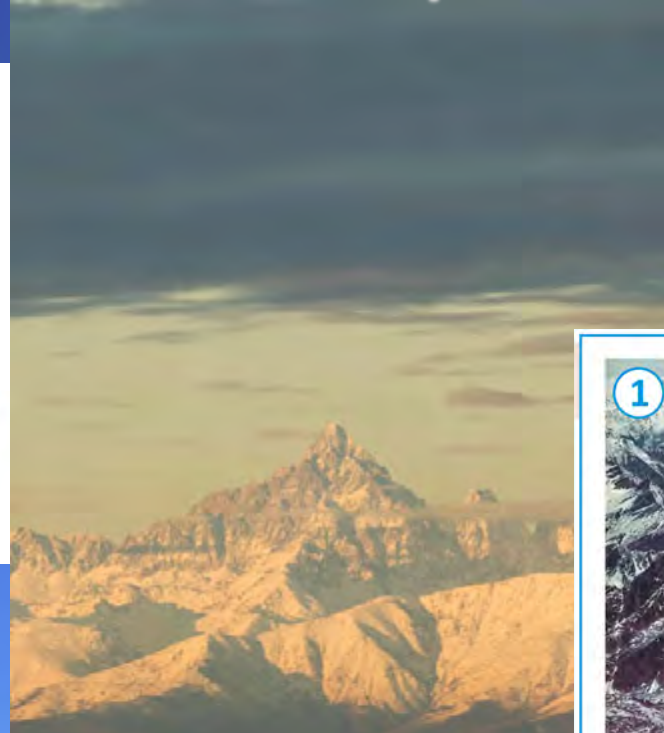
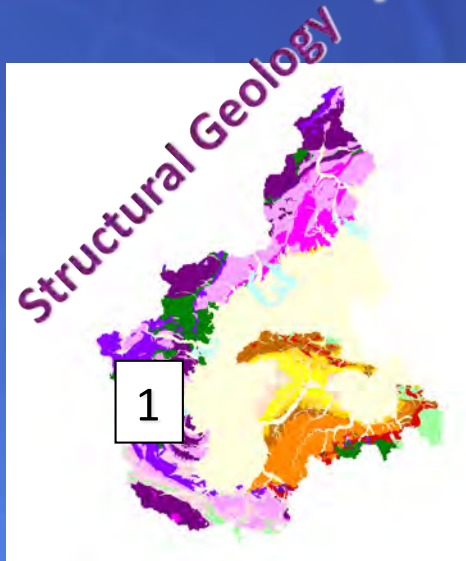
### The Time machine



### The window to the Alpine landforms



# The Monviso Massif and the Cottian Alps as symbols of the Alpine Chain





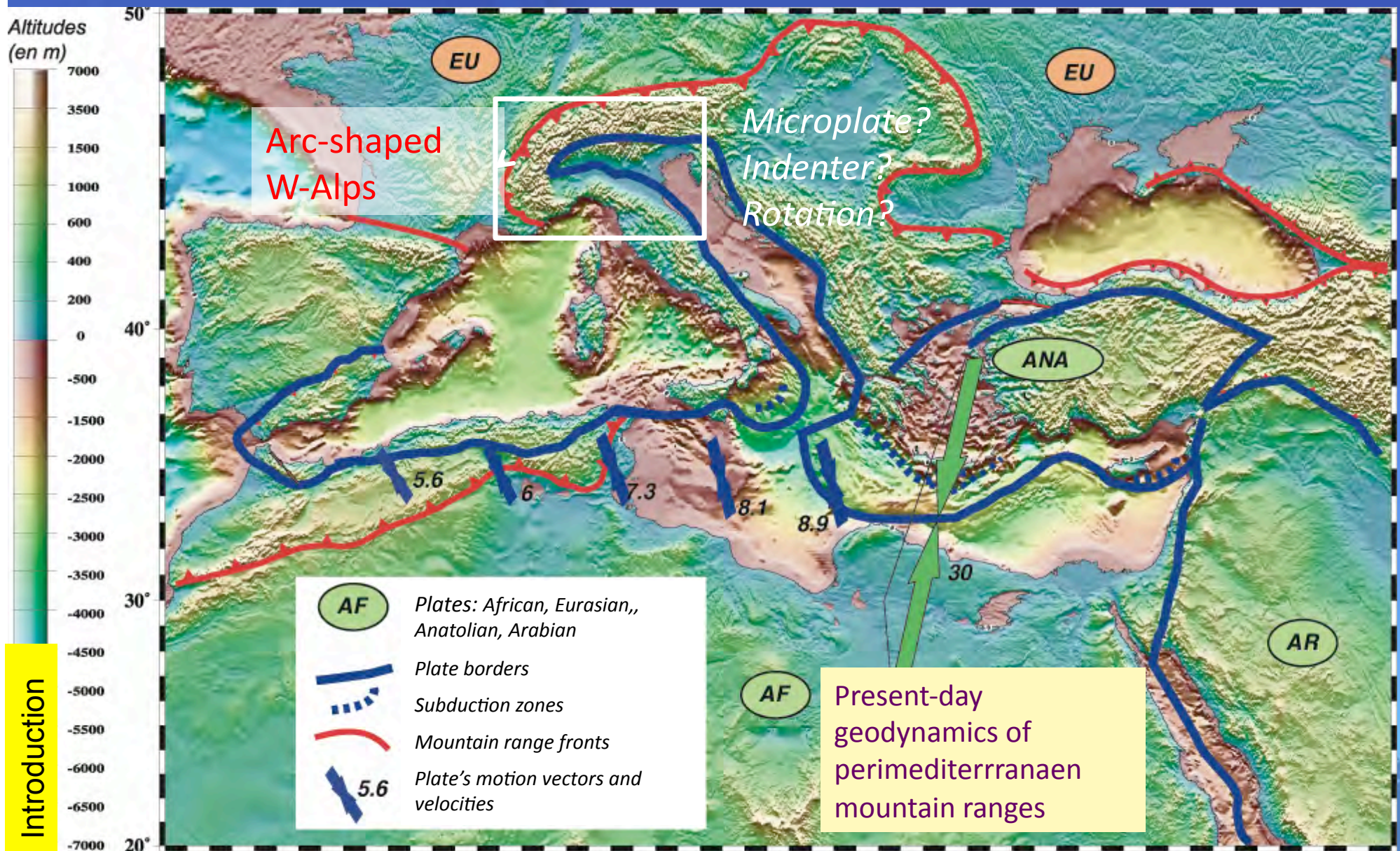
# The Alps,

A mountain chain  
Crossed by valley  
and tectonic structures

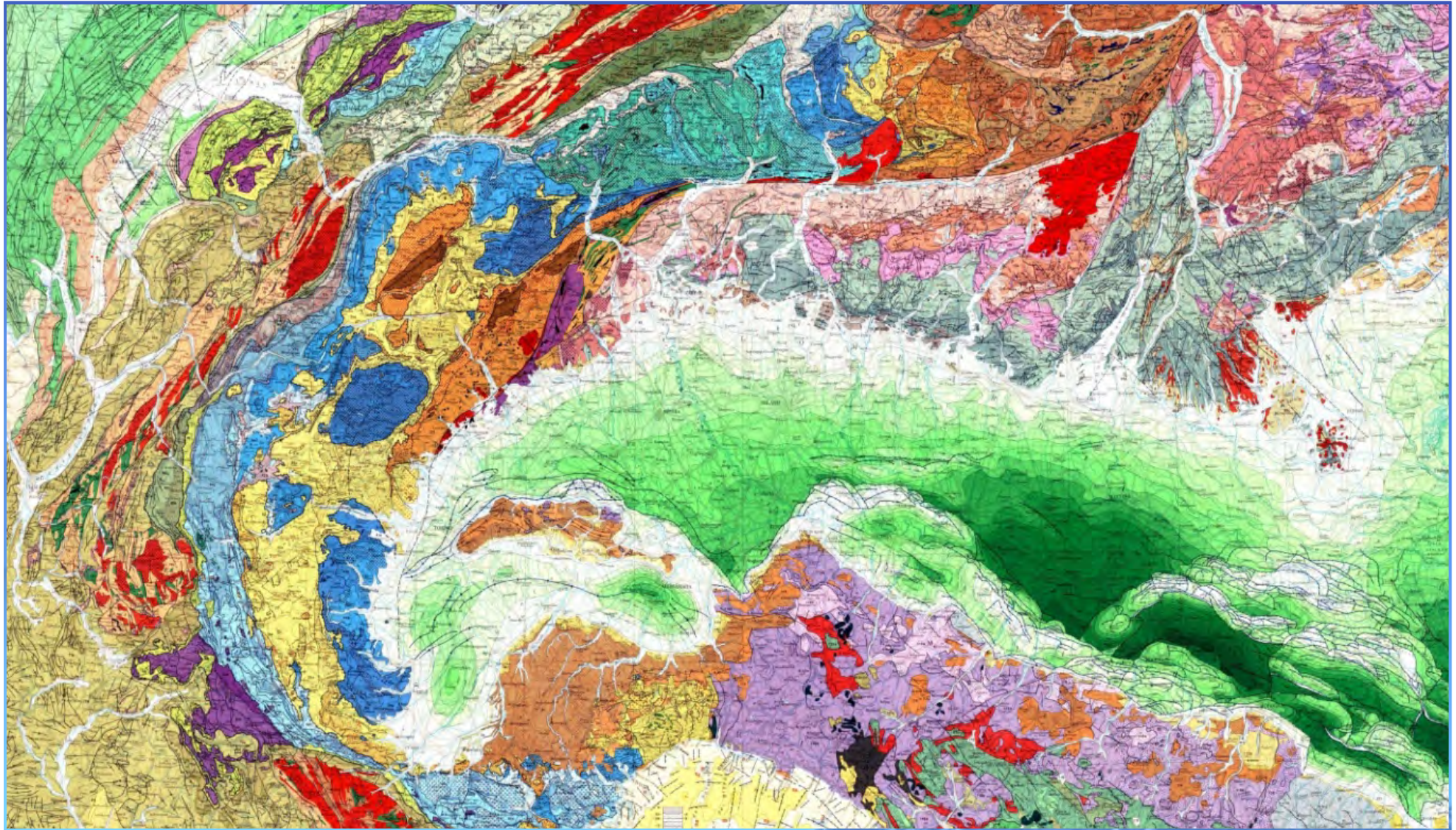




# Geodiversity of tectonic boundaries and mobility



# *Geodiversity of rocks and structural units*



# *Dynamic Geodiversity of the Western Alps*

How geodynamic processes affects **landforms** and modify **geomorphological landscape**?



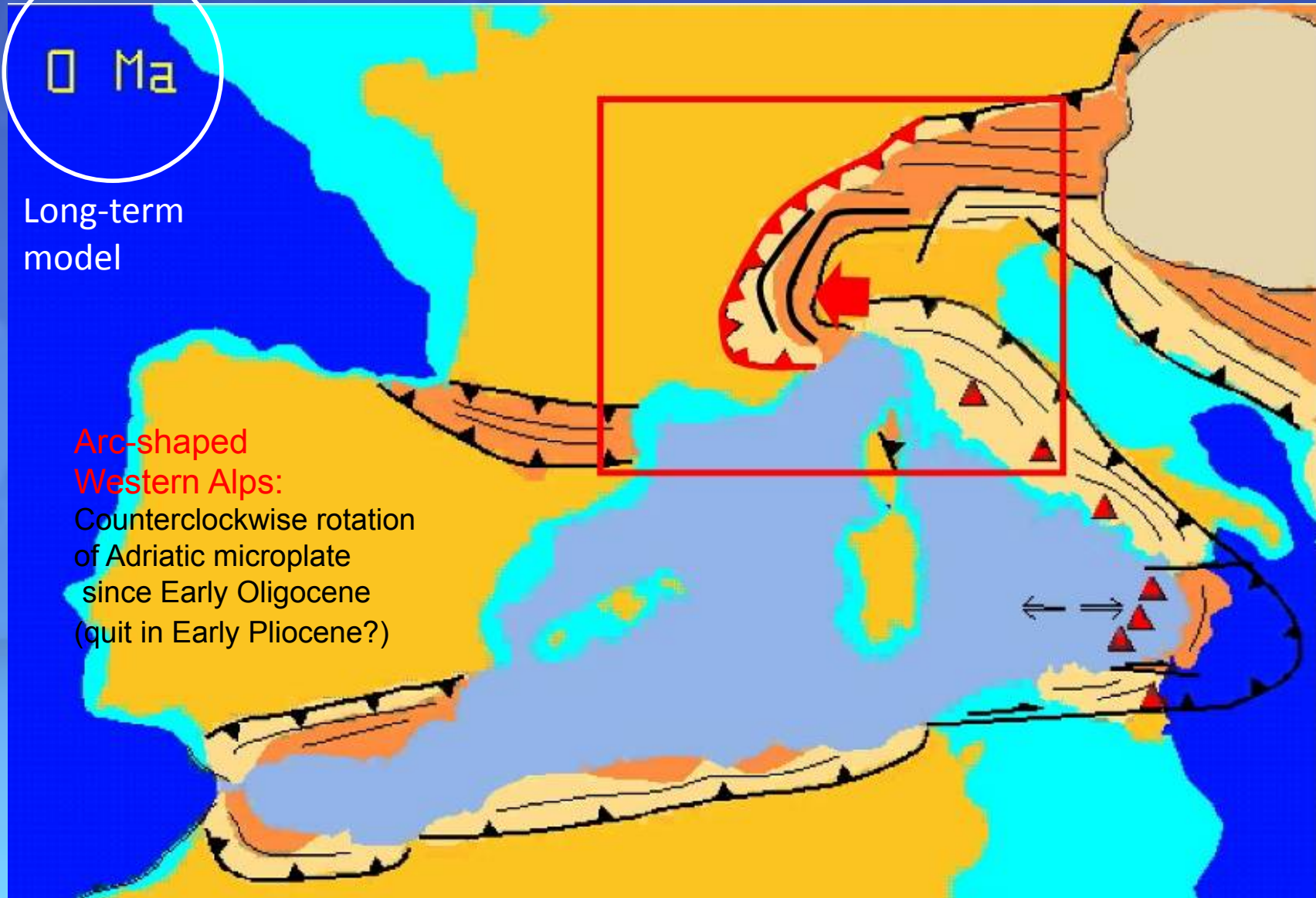
# Geodynamics: evolutionary stages

□ Ma

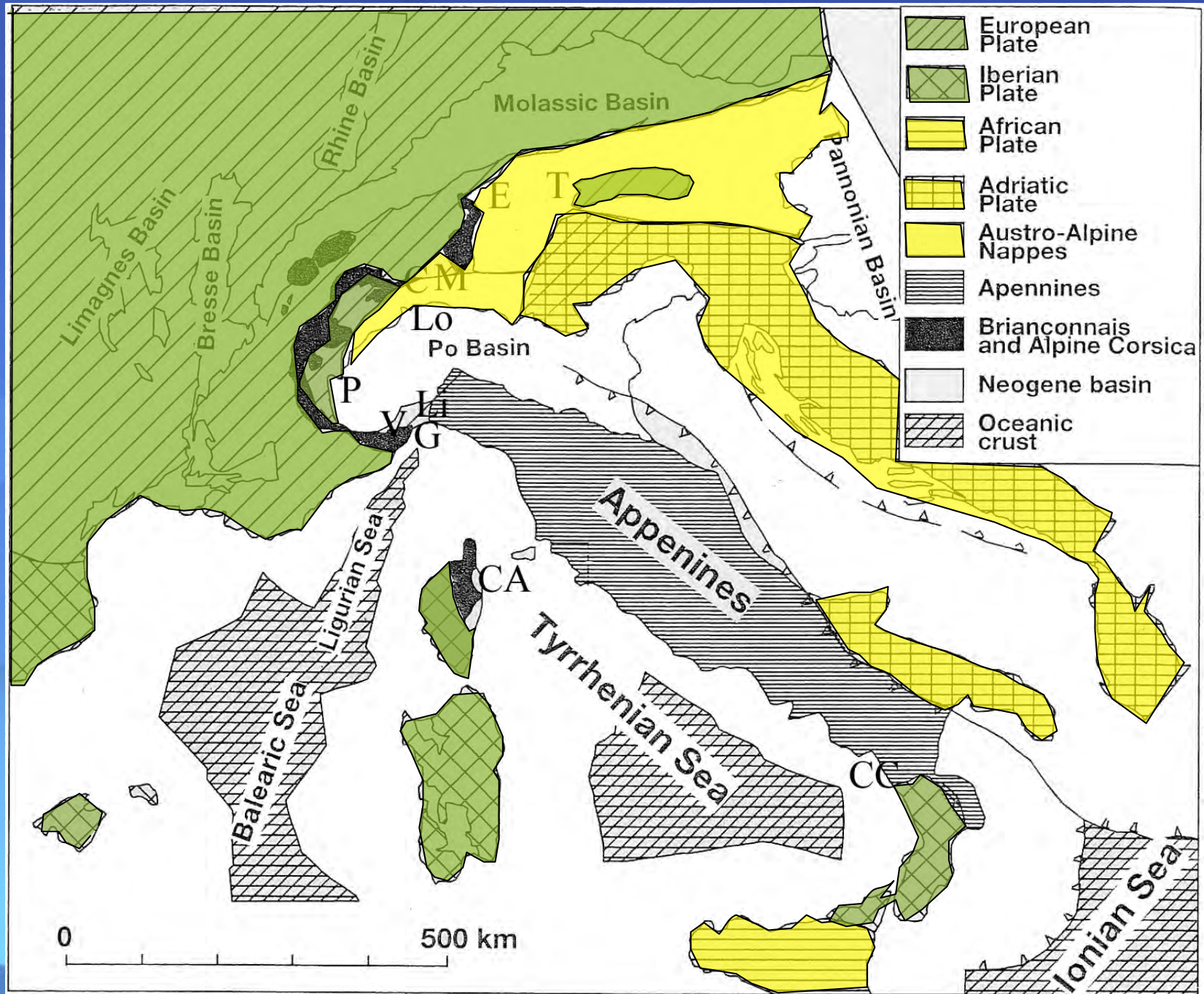
Long-term model

Arc-shaped Western Alps:

Counterclockwise rotation of Adriatic microplate since Early Oligocene (quit in Early Pliocene?)



# Present-day setting of structural/paleo-geographic units

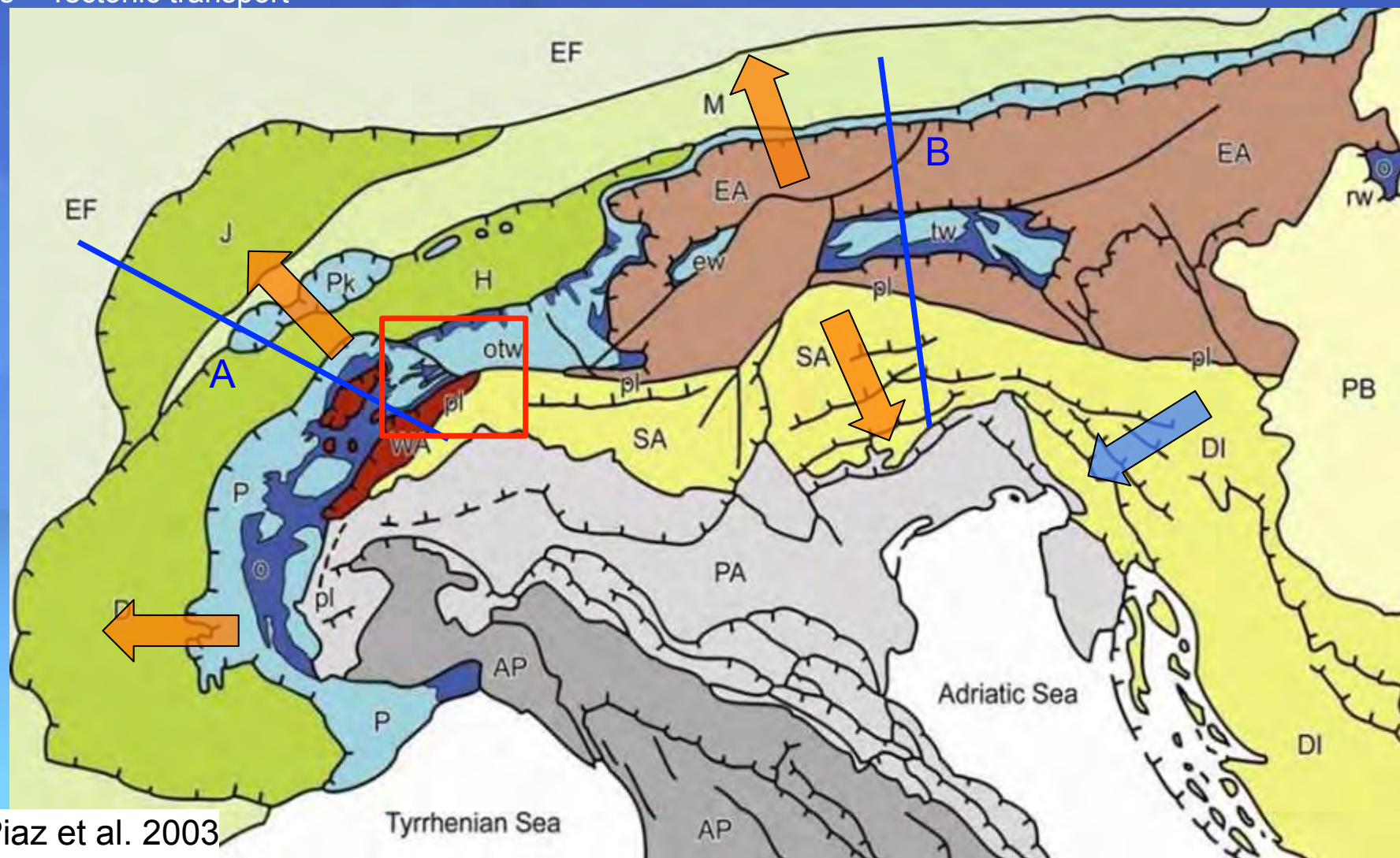


## Tectonic map of Alps

(1) Europe-vergent collisional belt: i) Western (WA) and Eastern (EA) Austroalpine; ii) Penninic domain: continental and ophiolitic (o) nappes in western Alpine arc (P) and tectonic windows (otw: Ossola-Ticino, ew: Engadine, tw: Tauern, rw: Rechnitz); Prealpine klippen (Pk); iii) Helvetic-Dauphinois (H-D) domain; iv) Molasse foredeep (M); v) Jura belt (J).

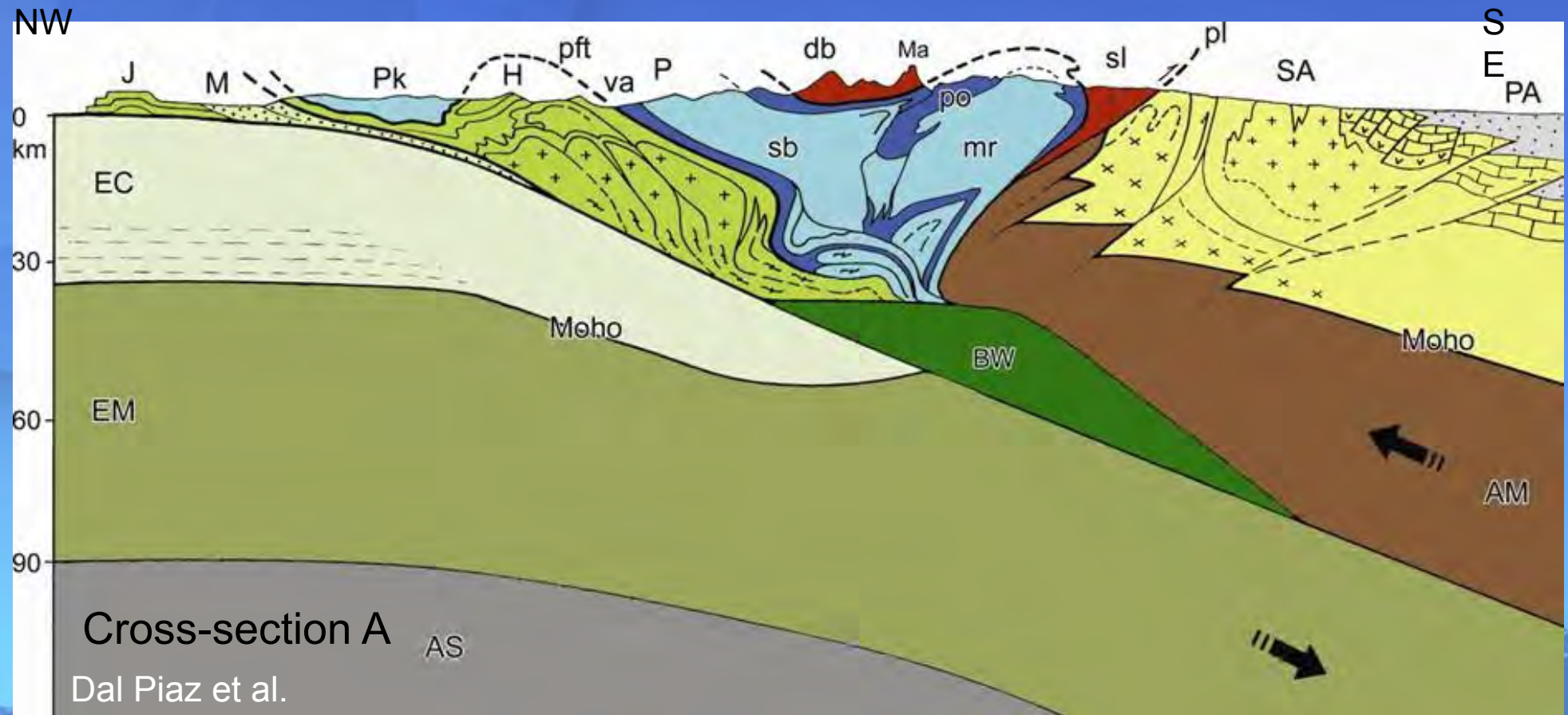
(2) Southern Alps (SA), bounded to the north by the Periadriatic lineament (pl). Pannonian basin (PB), European (EF) and Po Valley-Adriatic (PA) forelands, Dinaric (DI) and Apenninic (AP) thrust-and-fold belts.

Arrows = Tectonic transport



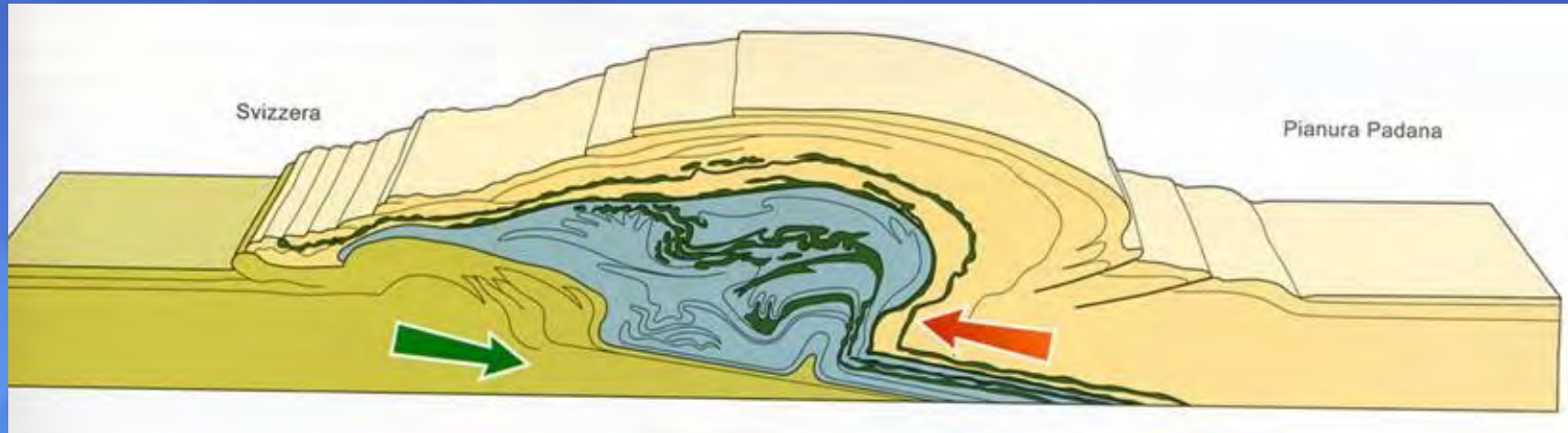
# Lithospheric section of north-western Alps

1) **Austroalpine: Sesia-Lanzo inlier (sl) and Dent Blanche nappe s.l. (db), including Matterhorn (Ma);** 2) Penninic domain (P): Piedmont ophiolitic units (po), Monte Rosa (mr) and Grand St. Bernard (sb) nappes, underlain by lower Penninic and outer Penninic Valais zone (va), Penninic klippen (Pk), Penninic frontal thrust (pft); 3) Helvetic basement slices and cover nappes (H); 4) Molasse foredeep (M); 5) Jura belt (J); 6) buried wedge (BW) of European mantle or eclogitized crustal units; 7) European lithosphere: continental crust (EC) and mantle (EM); asthenosphere (AS); 8) **Adriatic lithosphere: antithetic belt of Southern Alps (SA) and mantle (AM);** Periadriatic fault system (pl); 9) Padane-Adriatic foreland (PA).



# Emile Argand, Les Alpes

AustroalpinE (beige)



European  
foreland

Hellvetic

Penninic (blue)  
including Dent  
Blanche  
e Sesia-Lanzo (falda  
VI)  
black: ofiolitic unit

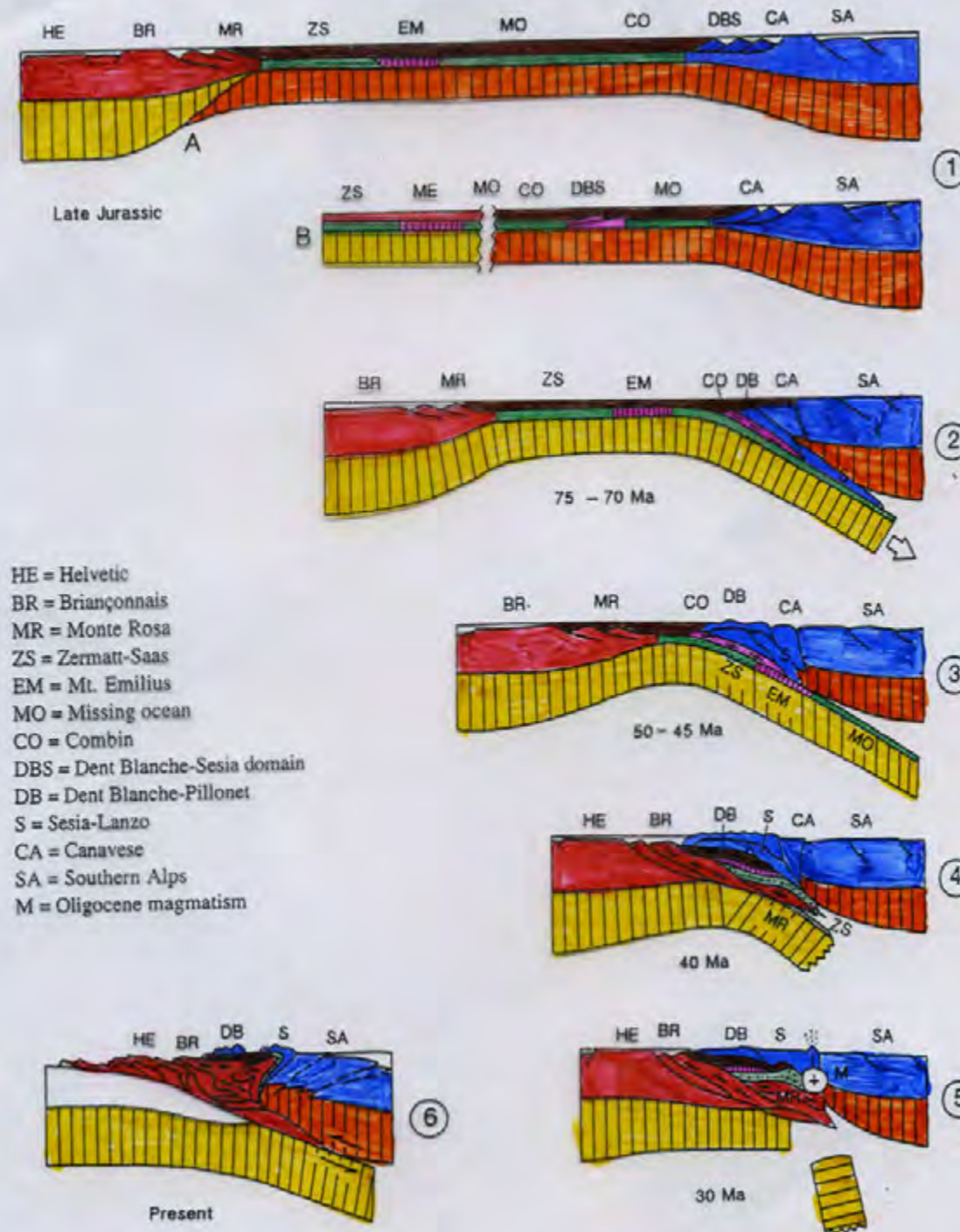
Southern Alps



# The Alps,

A mountain chain developed through several phases, during hundreds millions years

The cartoon of the orogenesis



Images by Massironi, 2011, geoNatHaz summer school



Westward panoramic view of the collisional suture from P. Dufour (Monte Rosa): From European margin (P. Dufour, W ridge, in the foreground) to the Adria margin (Cervino, East face), through Breithorn ophiolites (North face)



Falda della Dent Blanche (Africa) del  
M.te Cervino

Zona del Combin

Ofioliti di  
Zermatt-Sass

Adria/Piemontese Ocean (Zermatt-Sass) in Valtournanche (Cervinia), a a  
A geological contact with sharp geomorphological evidedence

M. Rosa  
(Europe)

Cervino  
(Africa)

Breithorn  
(Ocean)

Continent

Océan

La pyramide du Cervin (ici vue du nord) est un petit rideau continental, échoué sur les couches sédimentaires marines d'un océan disparu.  
La limite (ou contact) océan-continent est soulignée en jaune. Il y a 80 millions d'années, cette limite était mobile, mais elle était cachée sous la bordure d'un continent. Aujourd'hui elle est visible, mais figée dans la paroi de la montagne.

Zermatt-Saas ophiolites (Eclogite metamorphic facies)

Combin Zone (calcschist, metabasalt, greenschist facies)

Dent Blanche Unit (Adria plate or Africa indenter)

Cervino  
Gabbro  
285 Ma

# Find an hypothesis about the origin of the Alps

*Interpretation of different types of rocks as  
products of different geological environments*

**Pillow-lava basalts:**  
effusive igneous rock (volcanic)  
formed in a mid-ocean ridge  
in underwater environment



**Granite:**  
magmatic rock intrusive (plutonic)  
resulting from the slow crystallization  
of a deep magma  
in the environment of the continental crust

# The rocks are deformed by tectonic processes, characteristic of different parts of the earth's crust.

For example, the typical deformations that can be observed in the Alps include:

## Schistosity

in conditions of high temperature and oriented pressure the rock-forming minerals are distributed along the surfaces referred to as preferential surfaces of schistosity



## Folds

rocks deform slowly and progressively within the earth's crust, in conditions of high pressure and temperature



## Faults:

The rocks is deformed in blocks they slide relatively to each others. This phenomenon can occur in a relatively superficial conditions giving rise to earthquakes.



# Monte Rosa glaciers

## Geomorphological landscape of the Alps





**IL GHIACCIAIO DI BORS**



**IL GHIACCIAIO DELLE PIODE**



**I GHIACCIAI DELLA SESIA E DELLE VIGNE**



**IL GHIACCIAIO MERIDIONALE DELLE LOCCE**



# Storia e Futuro dell'Istituto "Angelo Mosso"

(Università degli studi di Torino, N.G.S –USA, R.Ph.S. – GB)

Inaugurato nel 1907, a 2.901 m s.l.m. presso il Col d'Olen, nel gruppo del Monte Rosa, per svolgere ricerche di **Fisiologia e Medicina**

Con Umberto Monterin, studio della **Meteorologia e Glaciologia**

**10 giugno 2000 un incendio**

Collaborazioni: Monterosa SpA e la Monterosa2000, il Parco Naturale Alta Valsesia e le Guide Alpine di Alagna e Gressoney

**L'Istituto oggi**  
**Nat-Risk- Laboratorio Neve e Suoli Alpini**  
**Meteomont, stazione meteorologica automatica**  
**Scuola di Fisiologia e Medicina d'Alta quota**

# IPROMO



2016: “Managing mountain resources and diversities: the role of protected areas”  
Ormea (Italy) 8-18 July 2016



## Cultural and Natural Geodiversity of Mountain Protected Areas

**Marco Giardino**

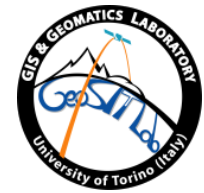
University of Torino, Italy – NatRisk Research Centre  
Earth Sciences Department – GeoSITLab Laboratory  
Via Valperga Caluso, 35 – 10125 Torino, Italy

[marco.giardino@unito.it](mailto:marco.giardino@unito.it)

Contributions by Enrico Giordano, Luca Ghiraldi, Alessandra Magagna and Luigi Perotti



università di torino  
centro interdipartimentale sui rischi naturali in ambiente montano e collinare



## **Scientific Knowledge and Governance of protected areas.**

**The role of authorities and local populations.**

**How protected areas safeguard their territories?**

- **Human-environment interactions**
- **Cultural and Natural Landscapes**
- **Geodiversity and Geoheritage**

## Cultural and Natural Geodiversity of Mountain Protected Areas Ormea (Italy) 8-18 July 2016

### Structure of the lecture

1. Geodiversity and cultural landscapes: theoretical concepts and specificities of case studies
2. **Geoheritage: research and valorization projects in a changing landscape**
3. **Examples of 3D modeling of cultural landscapes**
4. **Spreading Geodiversity awareness in schools through Multimedia**

*Cultural Landscapes*

**Geodiversity**

**3D models**

**Multimedia  
parks** ®

## Part 1 of the lecture

1. Geodiversity and cultural landscapes: theoretical concepts and specificities of case studies
2. Geoheritage: research and valorization projects in a changing landscape
3. Examples of 3D modeling of cultural landscapes
4. Spreading Geodiversity awareness in schools through Multimedia and Field trips

*Cultural Landscapes*

**Geodiversity**

**3D models**

**Multimedia  
parks @**

# 1. Specificities.....:

## *The Alps... from a personal viewpoint*



Cascina Paraccia (where I live), Sangone valley and Orsiera-Rocciavrè Mountain Park

***... Piemonte: a land at the foot of a mountain range...  
where human beings meet landforms and natural processes***

1. Specificities.....:

# *The Piemonte landscape...*



**... a territory expressing its geo-identity...**  
whose character depends from natural and human factors,  
and their interactions

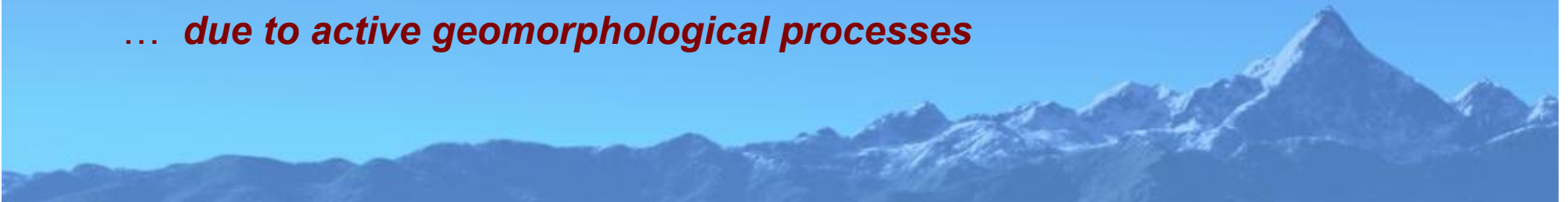
1. Specificities.....:

*a changing landscape...*



Tanaro River, just after Piemonte 2000 flood event

*... due to active geomorphological processes*





1. Specificities.....:

*revealing a unique geoheritage...*



Tanaro River, during ordinary flow conditions

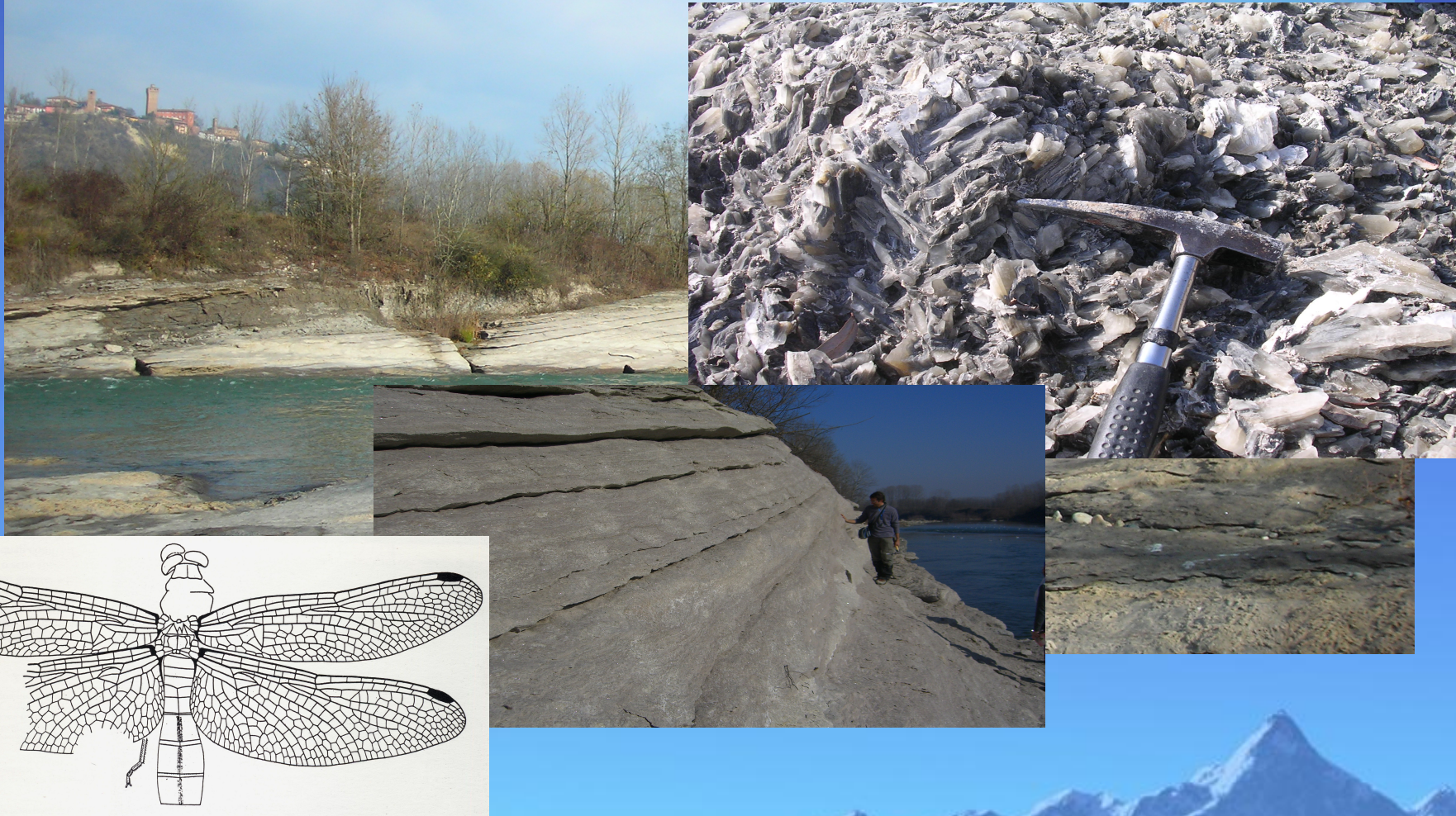
***Fresh outcrops of Messinian paleoclimatic features***



# Geoheritage to be studied, assessed, “valorized”...

## **Messinian salinity crisis:**

*in the Mediterranean area, huge amount of evaporitic rocks formed as a response of salinity variations from hyperhaline to ipohaline conditions ...*



## *Questions on...* Geodiversity and cultural landscape



Blanc des Blanc area

***HARD-*** or ***SOFT-GEOLOGY?***

# Questions on... Geodiversity and cultural landscape

Langhe Hills, SE Piemonte

**SOFT-** or **HARD-GEOLOGY?**



Barolo area

# Need fundamentals.... (*targeted definitions*)

## **GEODIVERSITY**

The natural range of geological, geomorphological soil and hydrogeological features of a (*mountain*) landscape

Gray, 2013

(updated)

## **GEOHERITAGE**

The range of (*mountain*) sites or areas of geological features with significant scientific, educational, cultural, or esthetic value

O'Halloran et al. 1994

Declaration of the Rights of the Memory of the Earth, Digne 2001

## **GEOSITE**

Earth surface processes and landforms telling history (*of the Alps*)

Panizza e Piacente, 2008

Serrano e Ruiz-Flano, 2007

## **GEOCONSERVATION**

The conservation of our non – living natural environment

ProGEO. The European Association for the Conservation of the Geological Heritage. 2011.

# Conceptual framework for “dimensions”

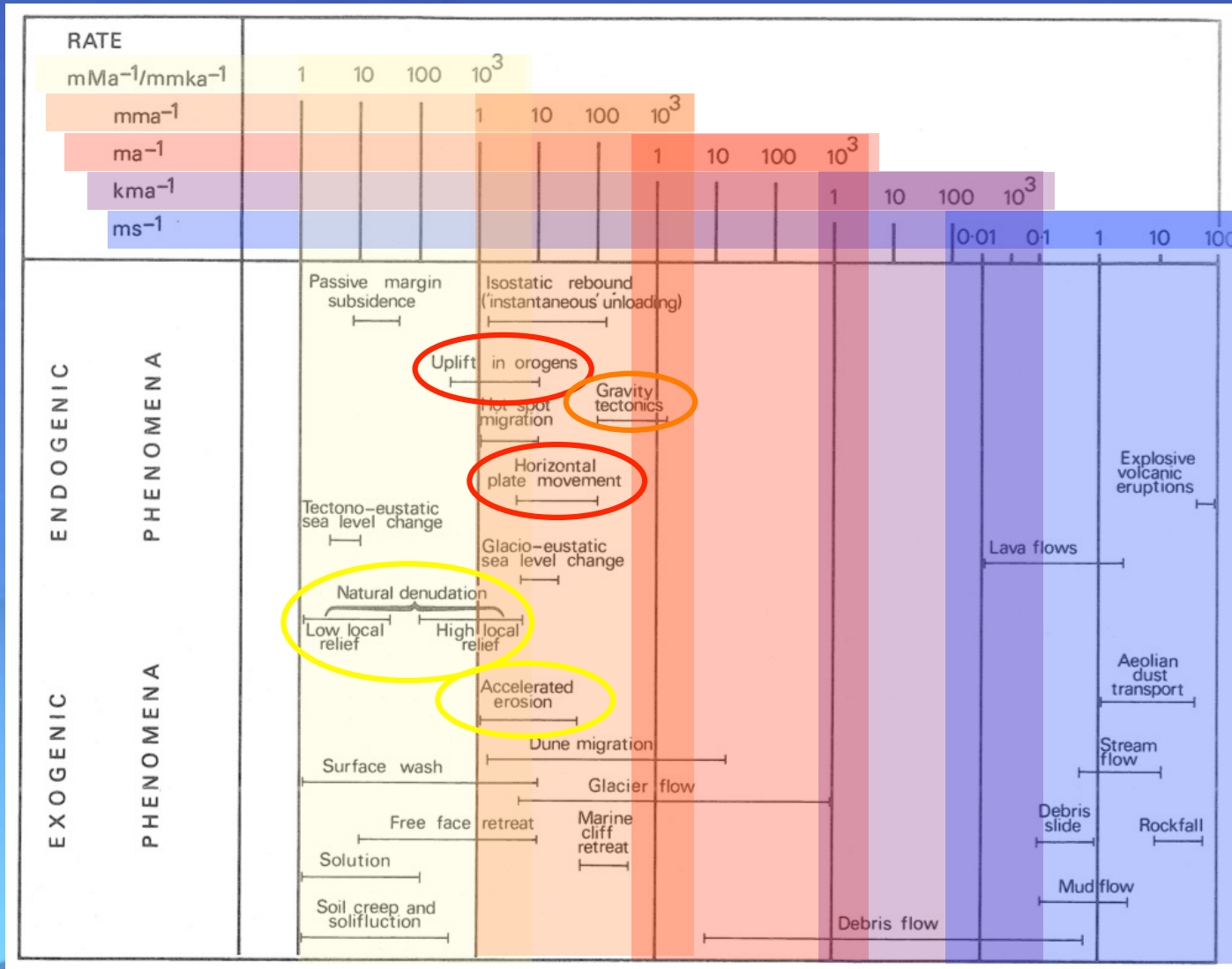
“DIMENSIONS”  
(Spatial, Temporal, Rate, ... )  
means “SCALES”

<b>Spatial SCALES</b> of landforms	<b>Linear dimensions</b> (km)	<b>Areal dimensions</b> (km <sup>2</sup> )	<b>Temporal duration</b> (years)
<b>Micro</b>	<b>&lt; 0.5</b>	<b>&lt;0.25</b>	<b>10</b>
<b>Meso</b>	<b>0.5 - 10</b>	<b>0.25 - 10<sup>2</sup></b>	<b>10<sup>3</sup></b>
<b>Macro</b>	<b>10 - 10<sup>3</sup></b>	<b>10<sup>2</sup> - 10<sup>6</sup></b>	<b>10<sup>7</sup></b>
<b>Mega</b>	<b>&gt; 10<sup>3</sup></b>	<b>&gt;10<sup>6</sup></b>	<b>&gt; 10<sup>7</sup></b>

Tables modified by Summerfield, 1991

# Rates of Geomorphic processes

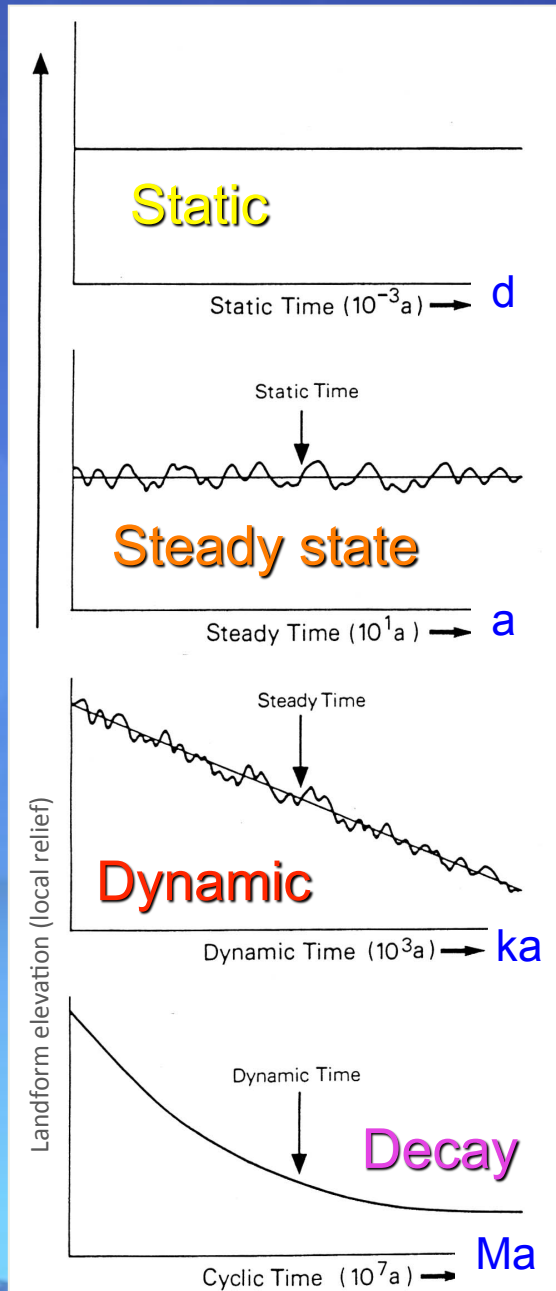
*Uplift, Isostasy, Horizontal plate movements, Gravity tectonics, Denudation, Erosion, ...*



Conceptual framework

# Landforms equilibrium and *EVOLUTION* in the W-Alps

Conceptual framework

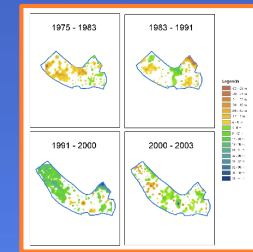
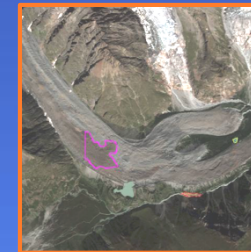


Increasing Time scale dimensions

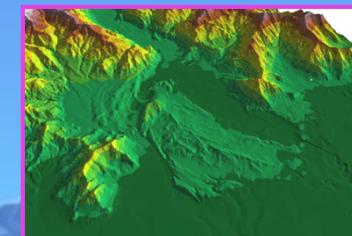
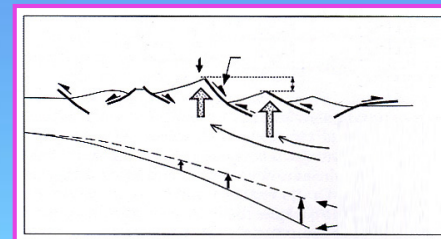
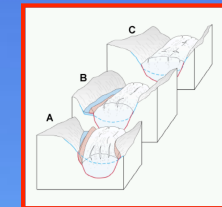


No significant changes in form, elevation, gradient

Significant (but periodical) changes in erosion, elevation, gradient



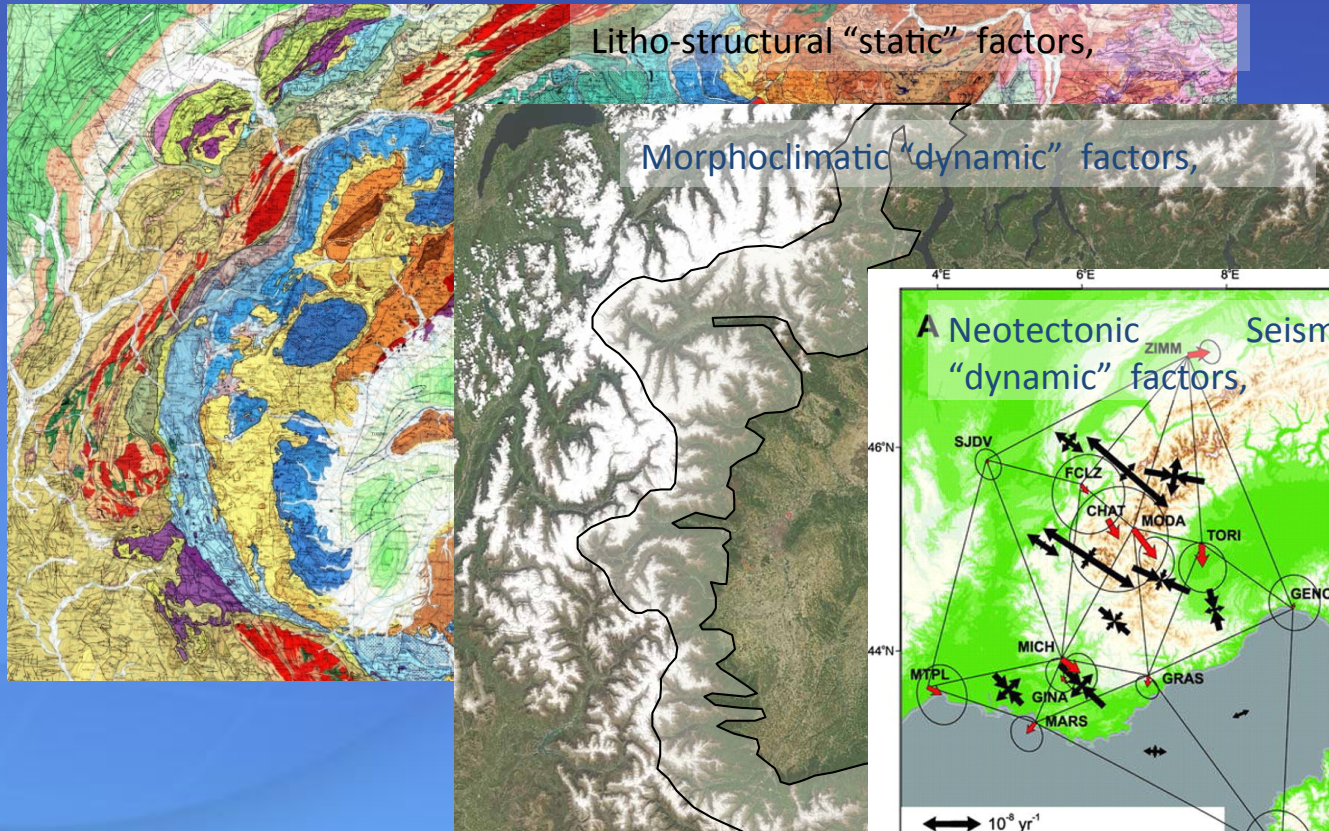
Trends in erosional rates, climate-tectonics markers



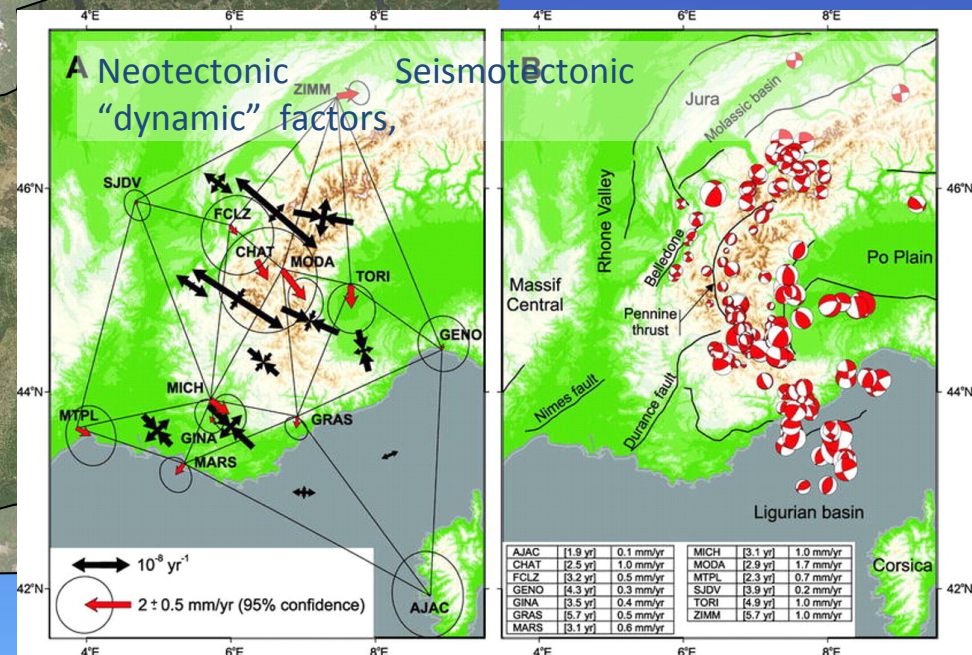
Progressive elevation changes, denudation



# Factors controlling the *Geodiversity* of the W-Alps



"System approach", relevant to geodiversity



Conceptual framework

Large areas:

Difficult assessments if based only on traditional geomorphological techniques (mapping, ...)

Need support of new Geomatic technologies (GPS, Mobile GIS, laser scanners, digital photogrammetry, remote sensing)

## Complex double-verging structure. 3 main sectors in the W-Alps (structural / paleogeographic)

### Litho-structural and tectonic constraints

lp = lower plate (external sector)

■ intrusive massif (Helvetic-Dauphinois) and ■ sedimentary/detrital deposits European Foreland:

PF = Penninic frontal thrust

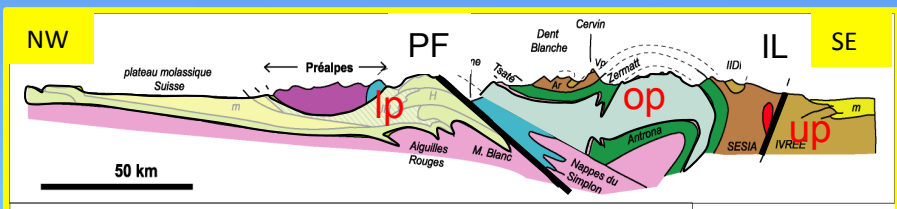
op = orogenic prism (axial sector)

continental crust rocks and metasedimentary covers (■ Penninic and ■ Australpine), ■ oceanic lithosphere sections, cover units from the ocean facing continental edges and ■ orogenic flysch units,

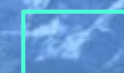
IL = Insubric Line

Internal sector = upper plate

■ SouthAlpine (basement rock with lower continental crust and upper mantle rocks).

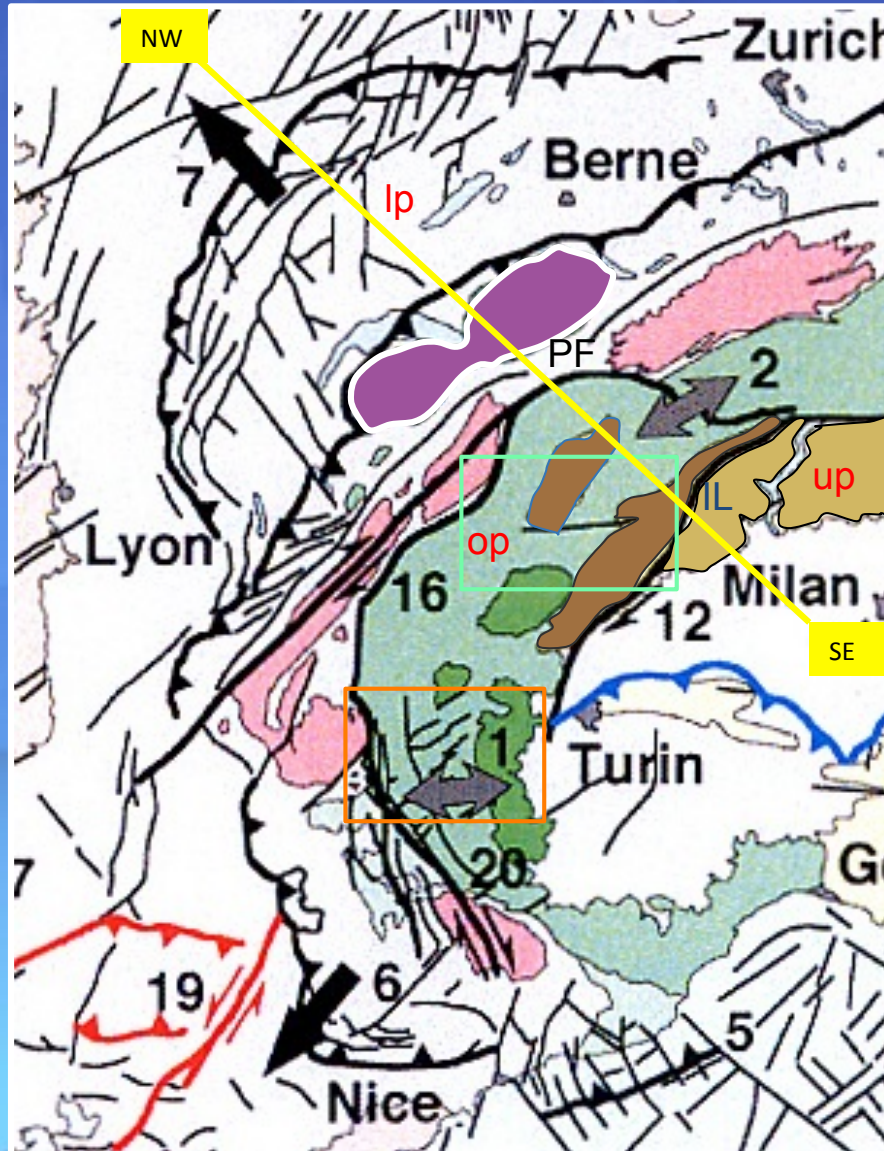


Susa valley



Aosta valley

Case studies: W-Alps, central sector





















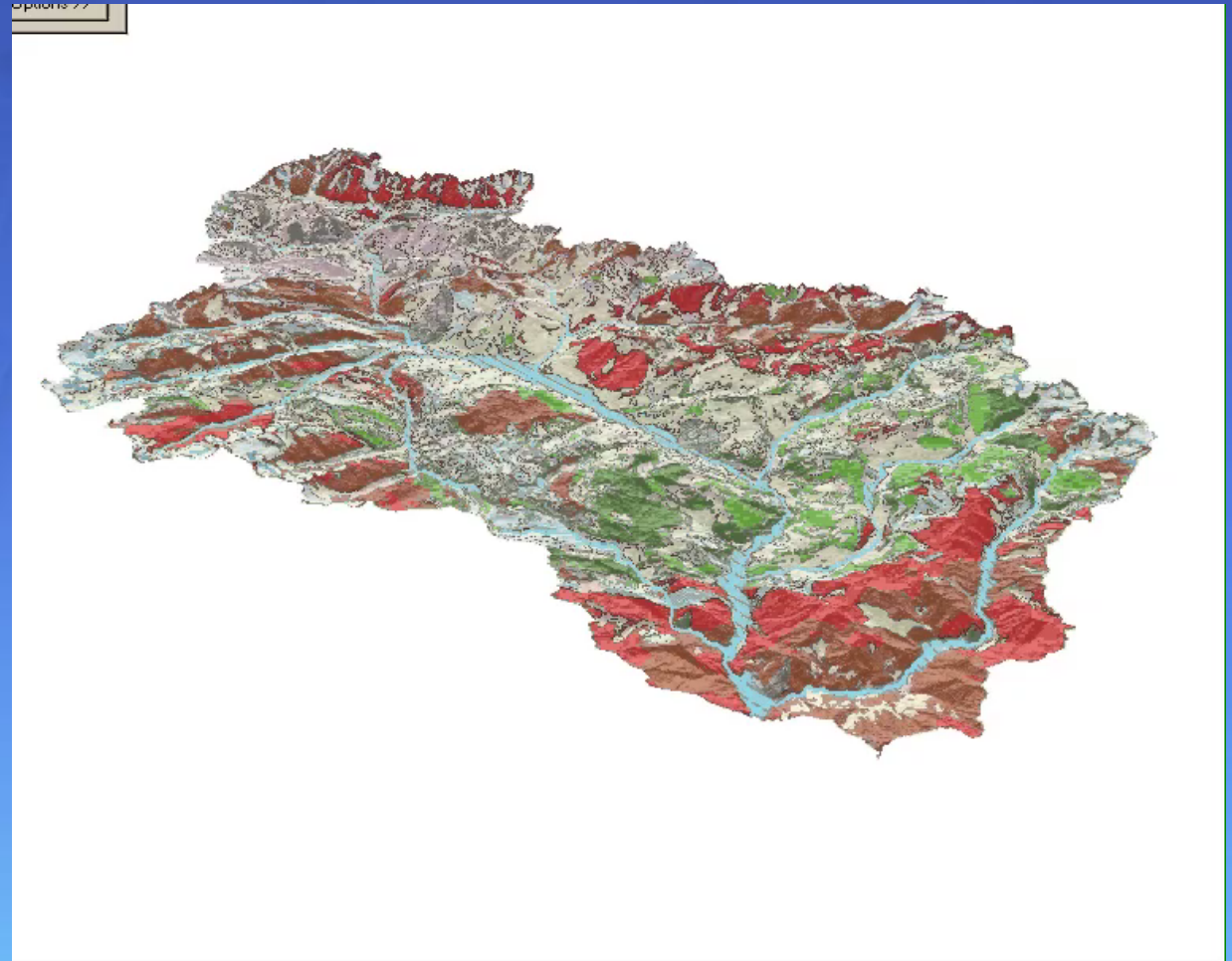


## → “Lithotechnical Map” (regional scale)

Simplified legend,  
classification oriented  
to enhance different  
geomorphological  
behaviour

### Classi litologiche

-  Accumuli di frana
-  Calcari, dolomie
-  Calcescisti
-  Conglomerati, flysch
-  Coperture sedimentarie non differenziate
-  Depositi alluvionali
-  Depositi glaciali
-  Detrito di versante
-  Gessi, carniole
-  Ghiacciai
-  Graniti, metagraniti, ortogneiss, metagranofiri, porfiroidi, filoni lamprofirici
-  Micascisti, paragneiss, metaconglomerati
-  Pietre Verdi (prasiniti, anfiboliti, metabasalti, metagabbri, gabbri)
-  Quarziti
-  Scisti neri, scisti arenacei, arenarie micacee, marmi fillitici
-  Serpentiniti



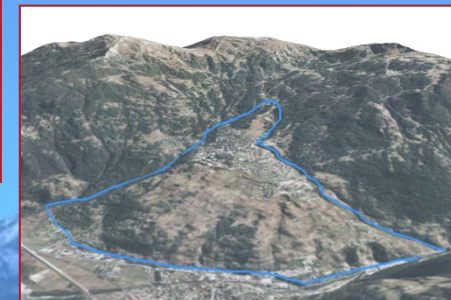
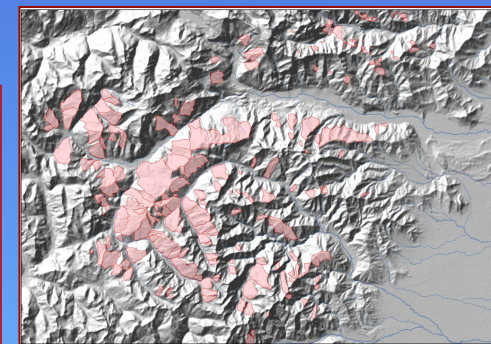
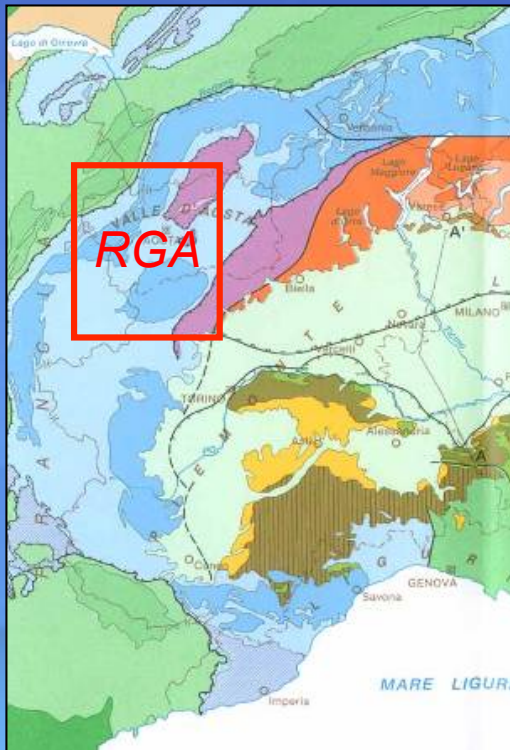
# Regional Geological Approach (RGA)

RGA = analysis of

- 1) large-scale, long-term features
- 2) geomorphological, lithological and structural: general factors of geodiversity of the mountain relief

RGA allows interpretation of

- 1) evolutionary stages of the mountain relief
- 2) regional independent variables, offering a “static” conditioning to the geodiversity (e.g. landslides: “internal” causes, lowering shear strength)



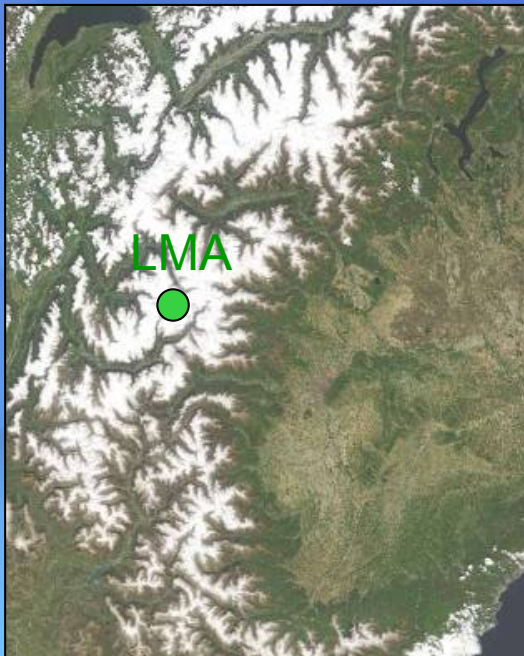
# Local “Morphodynamic” Approach (LMA)

Landform, process =  
*Single element of the  
dynamic environmental  
system*

LMA = study of characteristic landforms, rocks, structures and processes, relevant to understand (and assess) geodiversity

LMA allows

- 1) control on dynamic factors of geodiversity (e.g. “external” causes, increasing stress )
- 2) Process modelling and detailed geodiversity assessment

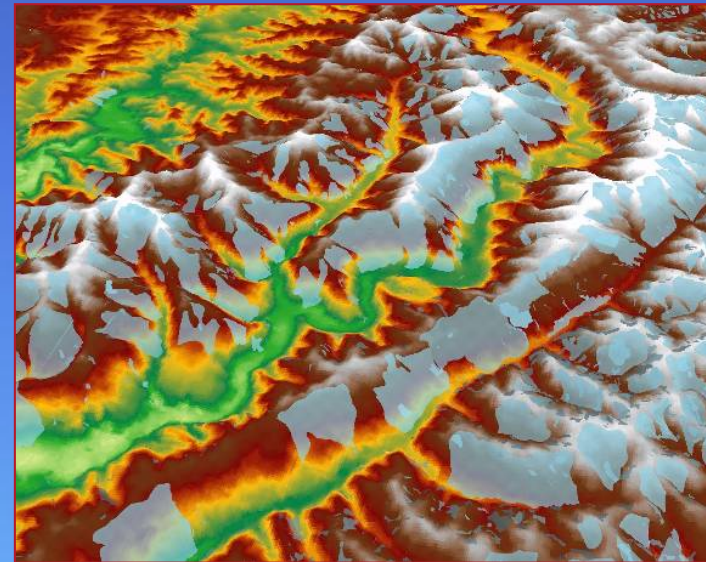
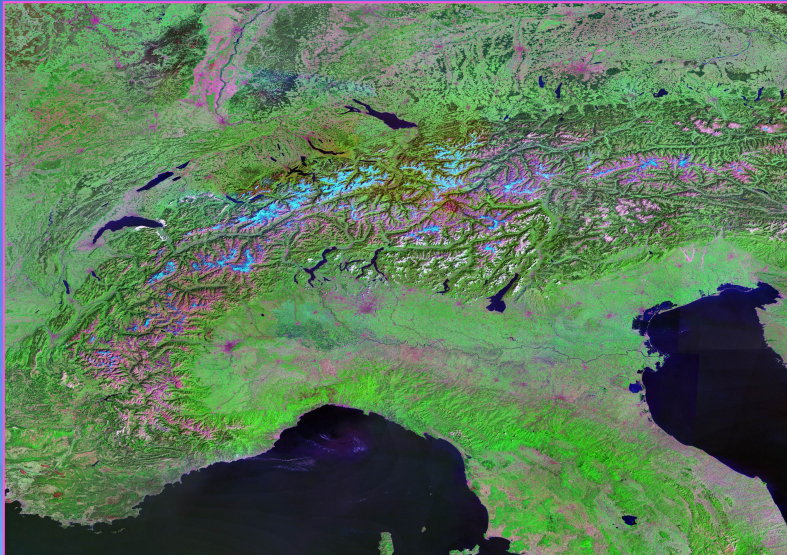


# RGA: appropriate Geomatics supports

Since **Regional Geological Approach** to NW-Alps is devoted to analyze:

A) long-term, large-size features representing independent variables to geodiversity;

B) statistical properties and geographic distribution of geomorphological elements in a certain area ;



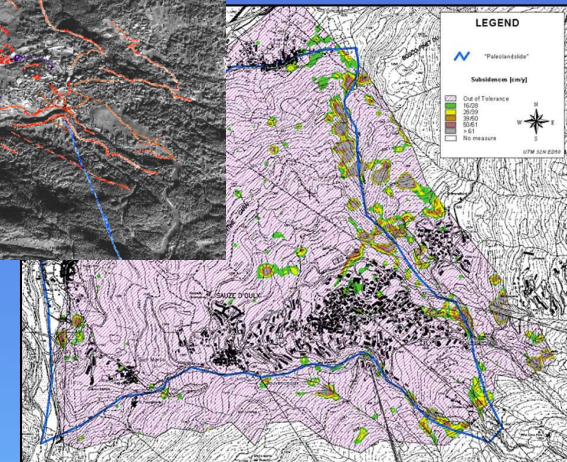
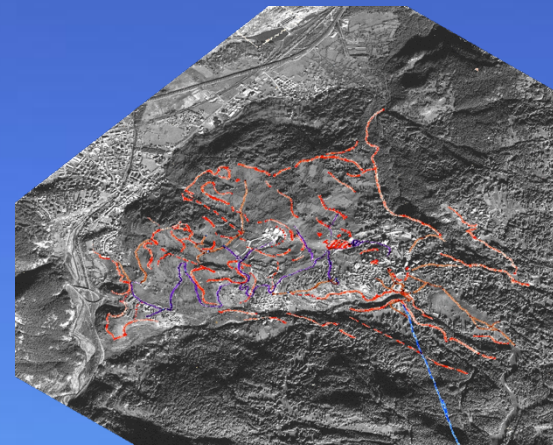
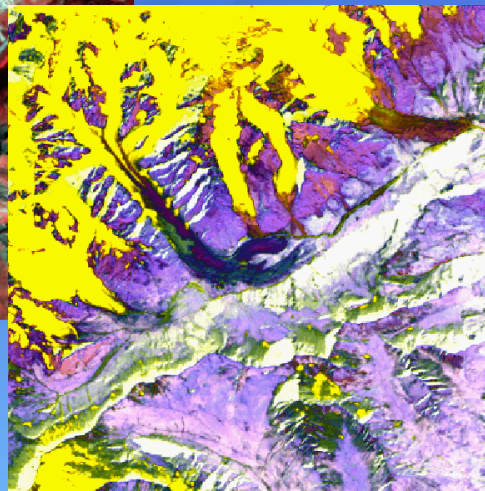
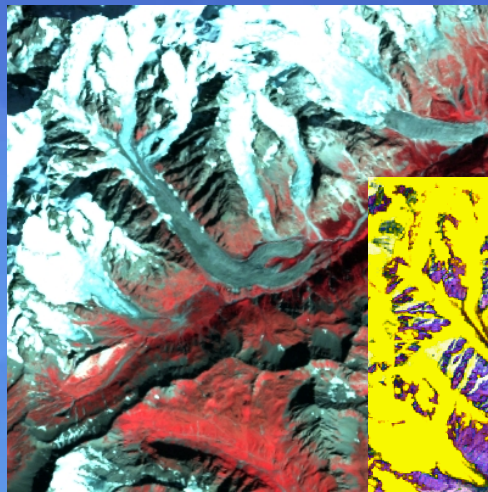
RS applications for **RGA**: LR satellite images, DEM/DSM (satellite),

*Presented case studies: A) whole mountain region; B) single valley (basin) : Western Alps (Susa-Chisone sector), Segusino Glacier basin (Susa Valley)*

# LMA: appropriate Geomatics supports

Since Local “Morphodynamic” Approach is mainly devoted to analyze:

- C) landforms and processes of a valley sector relevant to understand mechanism of relief evolution and locate geosites
- D) evolutionary stages and rates of single geological phenomena relevant to process models and geodiversity assessment



Local Morphodynamic Approach

RS applications for LMA: MRS and HRS images, Hyperspectral AS, SAR, LIDAR.

C) Valley sector/slope and D) single phenomenon case studies



# IPROMO



2016: “Managing mountain resources and diversities: the role of protected areas”  
Ormea (Italy) 8-18 July 2016



## Cultural and Natural Geodiversity of Mountain Protected Areas

**Marco Giardino**

University of Torino, Italy – NatRisk Research Centre  
Earth Sciences Department – GeoSITLab Laboratory  
Via Valperga Caluso, 35 – 10125 Torino, Italy

[marco.giardino@unito.it](mailto:marco.giardino@unito.it)

## Part 1 of the lecture

1. Geodiversity and cultural landscapes: theoretical concepts and specificities of case studies
2. Geoheritage: research and valorization projects in a changing landscape
3. Examples of 3D modeling of cultural landscapes
4. Spreading Geodiversity awareness in schools through Multimedia and Field trips

*Cultural Landscapes*

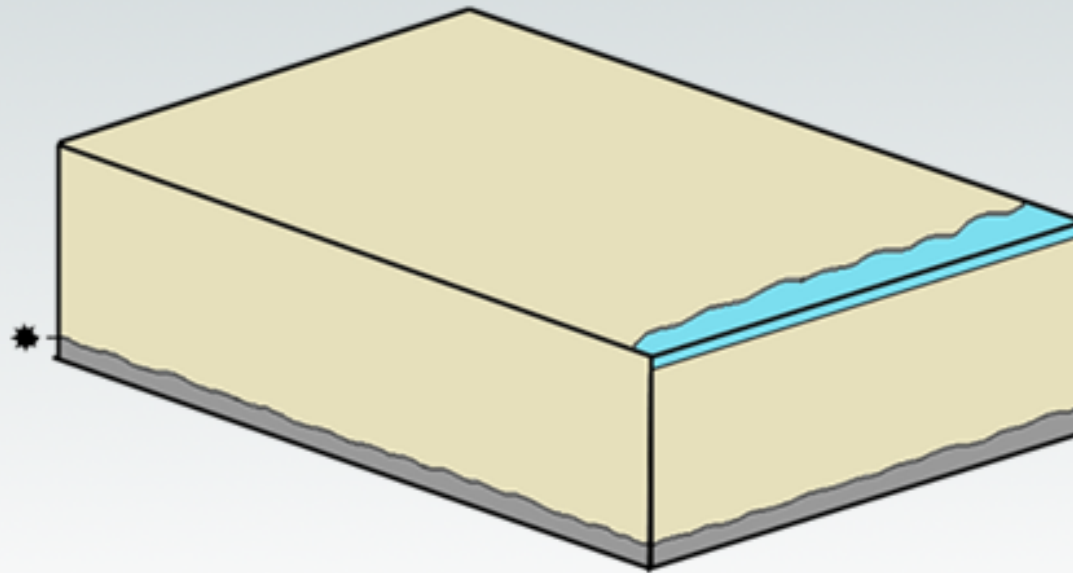
**Geodiversity**

**3D models**

**Multimedia  
parks @**

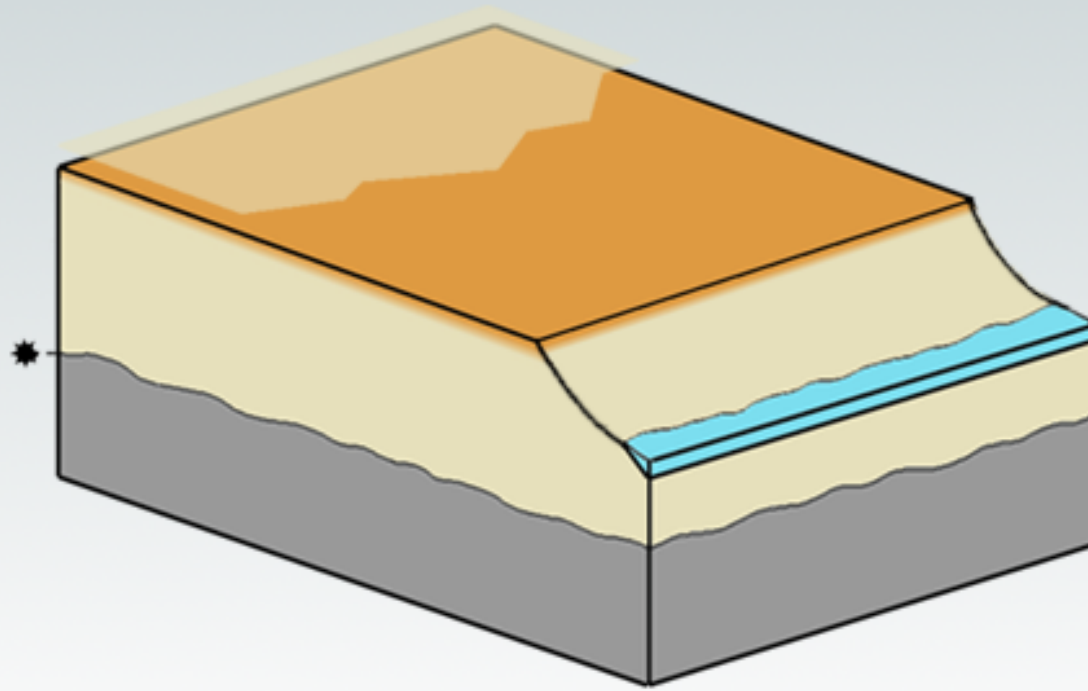
## REGIONAL GEOLOGICAL APPROACH

allows interpretation of evolutionary stages of the mountain relief



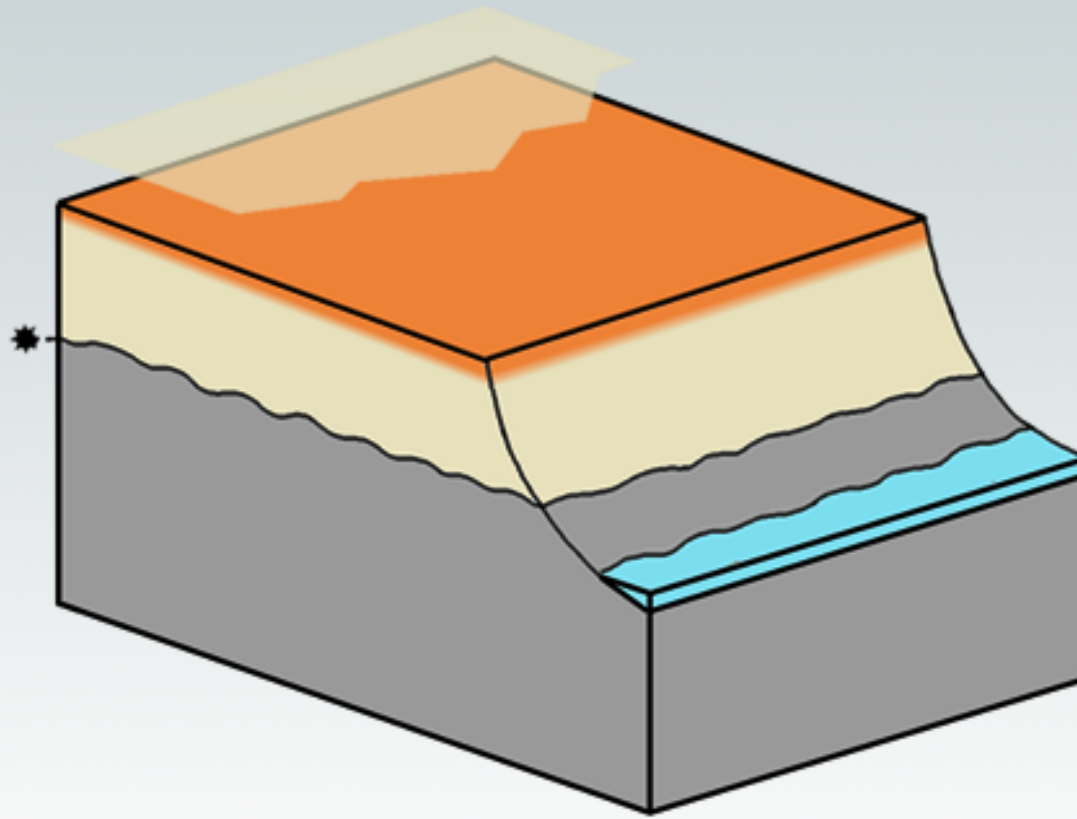
**EROSIONAL  
DEEPENING**

**TECTONIC  
UPLIFT**

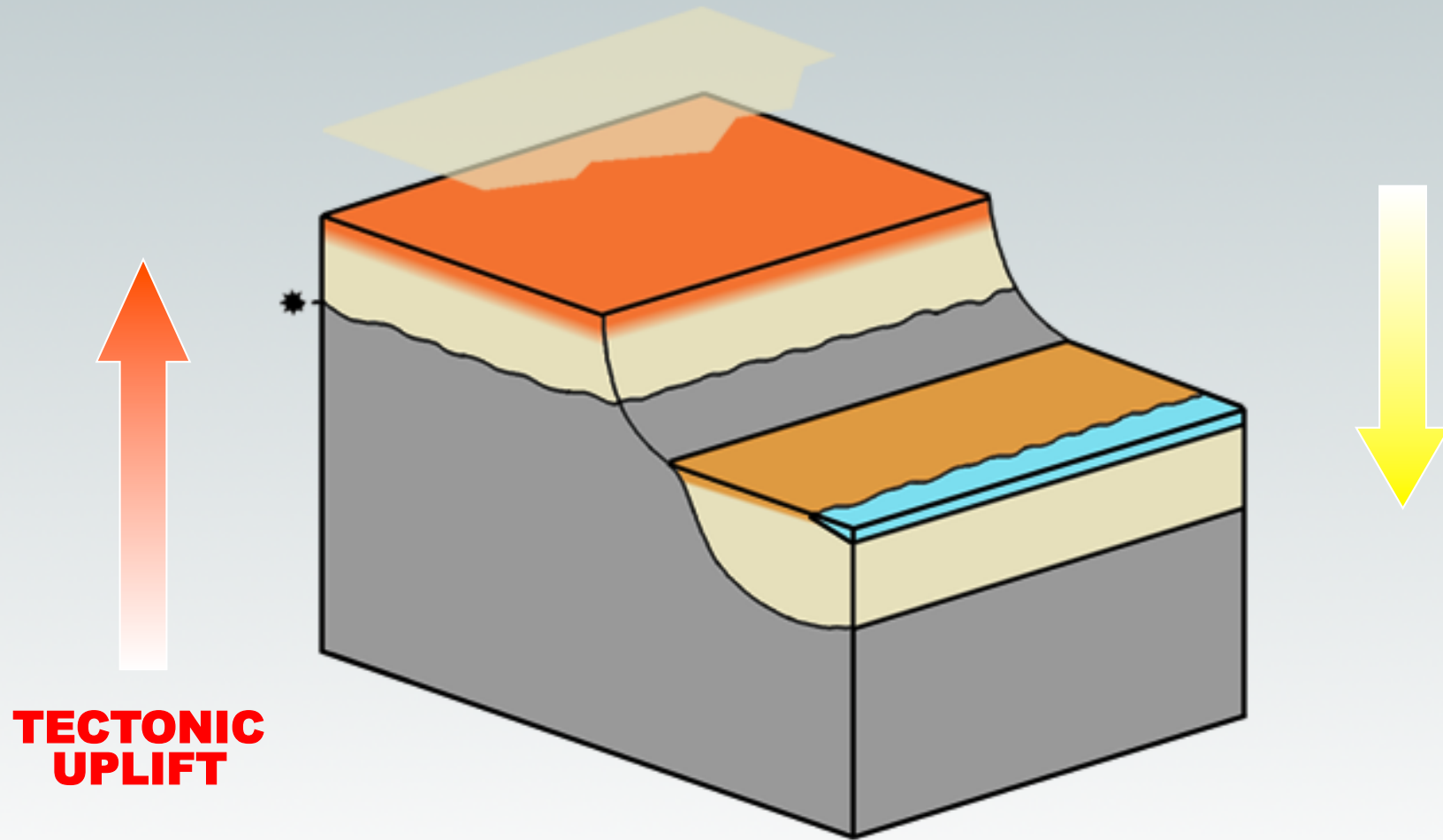


**EROSIONAL  
DEEPENING**

**TECTONIC  
UPLIFT**



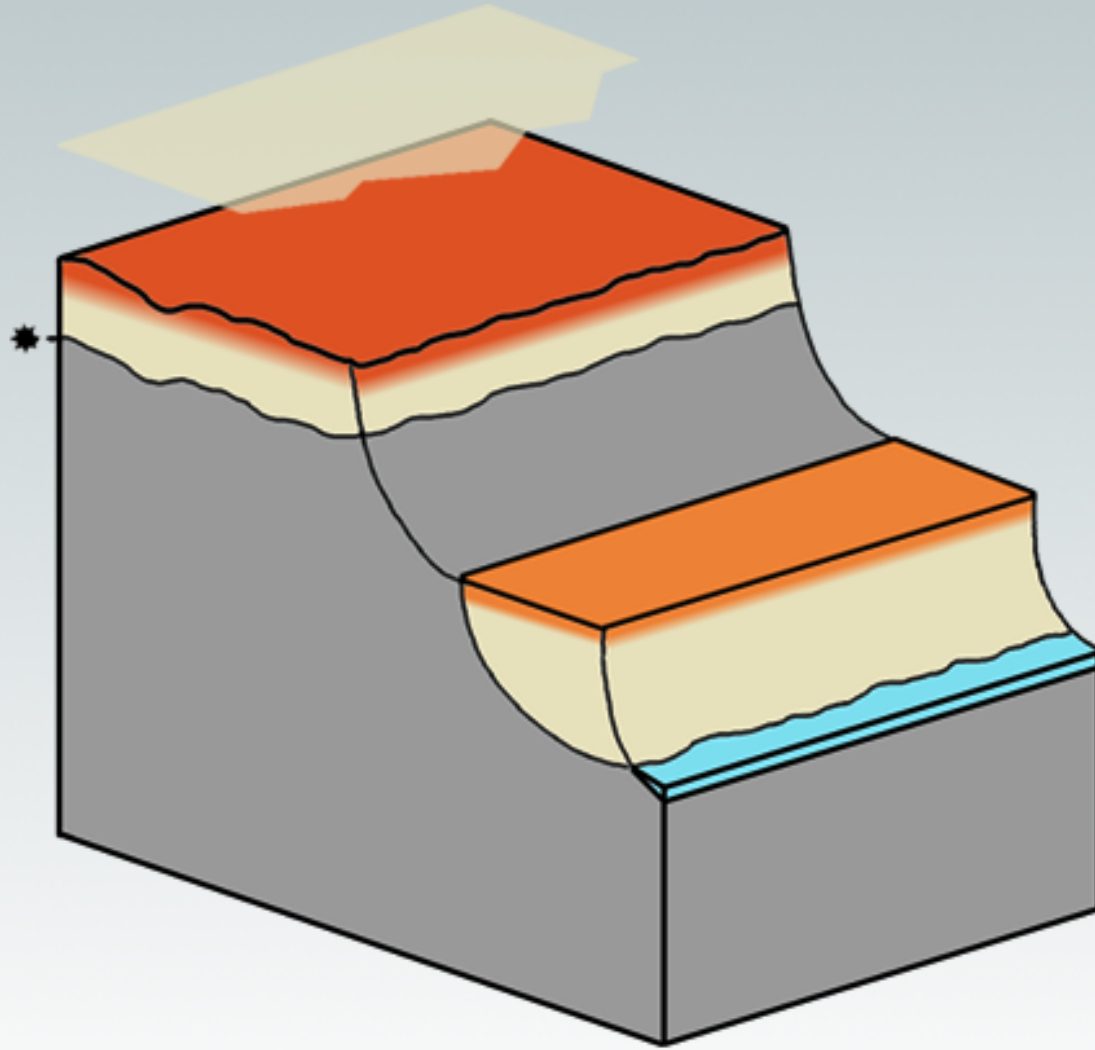
**EROSIONAL  
DEEPENING**



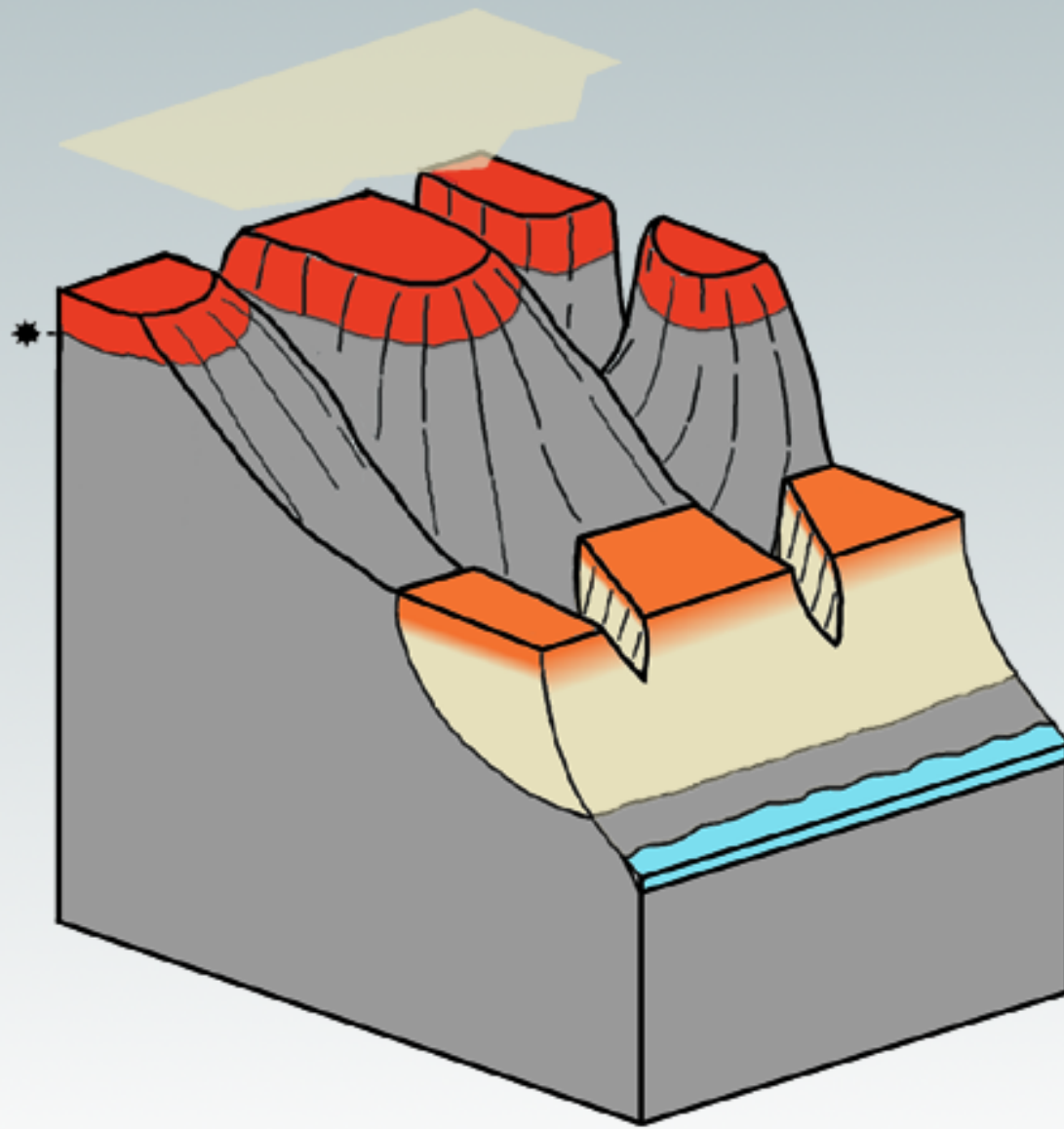
**TECTONIC  
UPLIFT**

**EROSIONAL  
DEEPENING**

**TECTONIC  
UPLIFT**



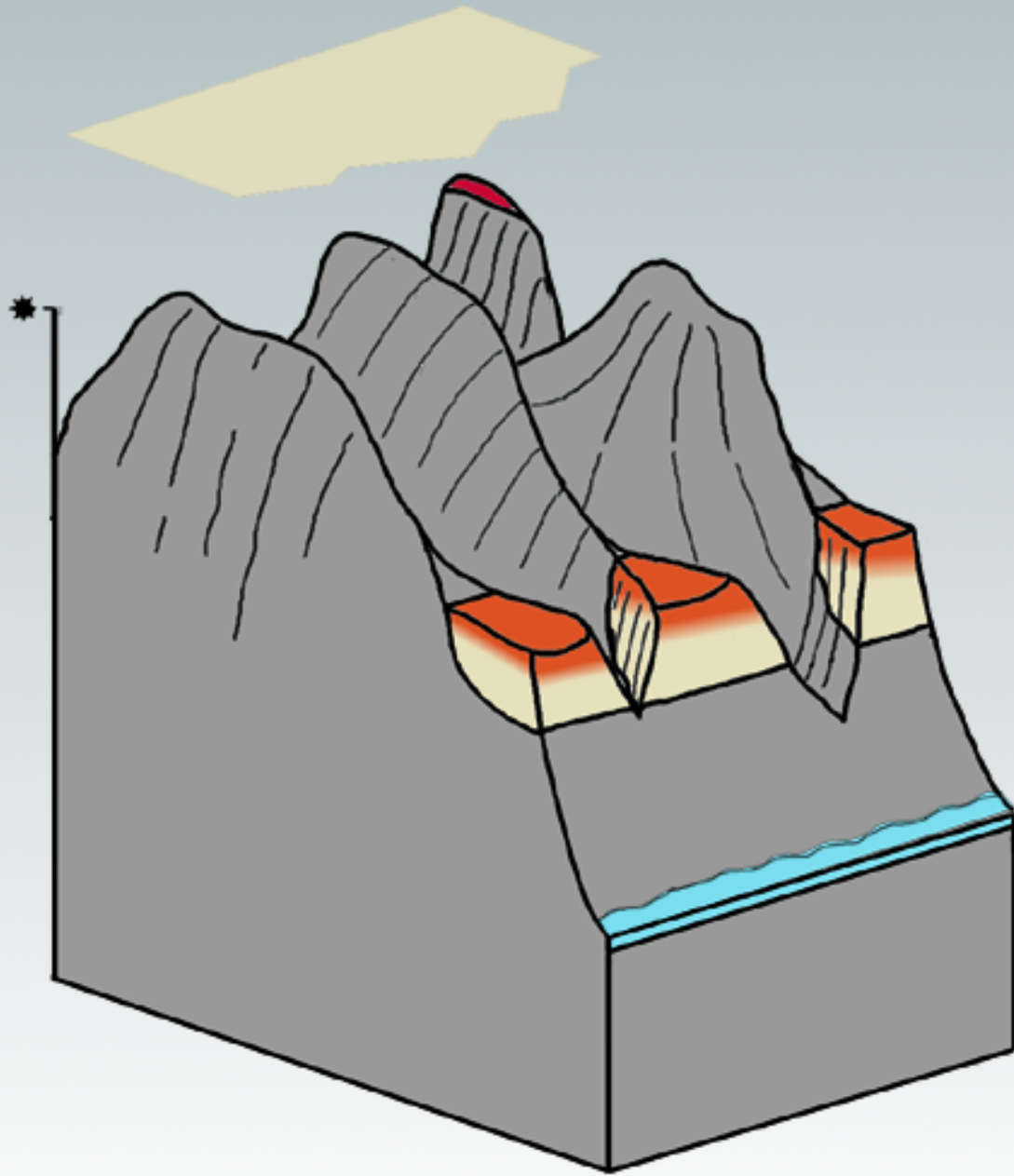
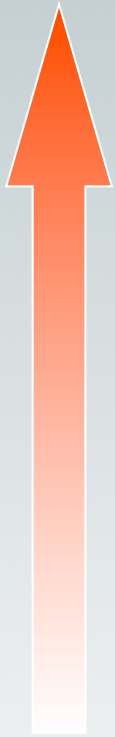
**TECTONIC  
UPLIFT**



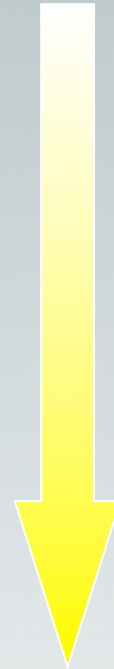
**EROSIONAL  
DEEPENING**



**TECTONIC  
UPLIFT**



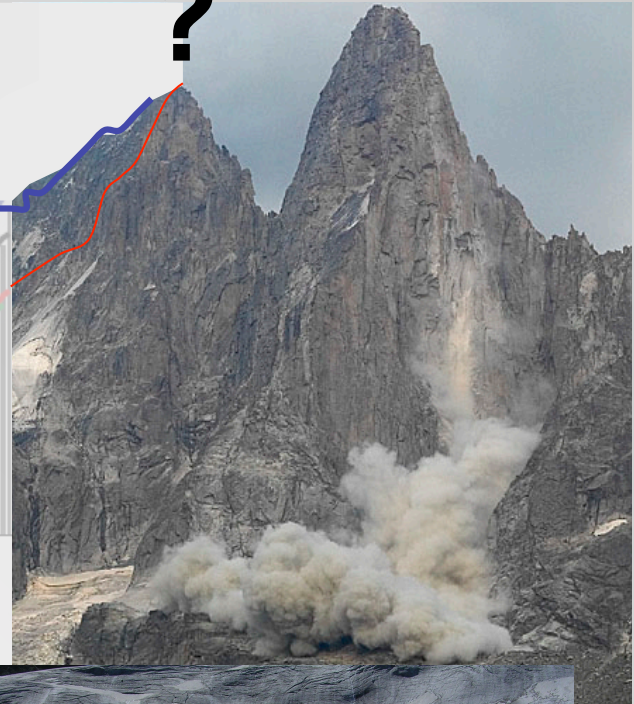
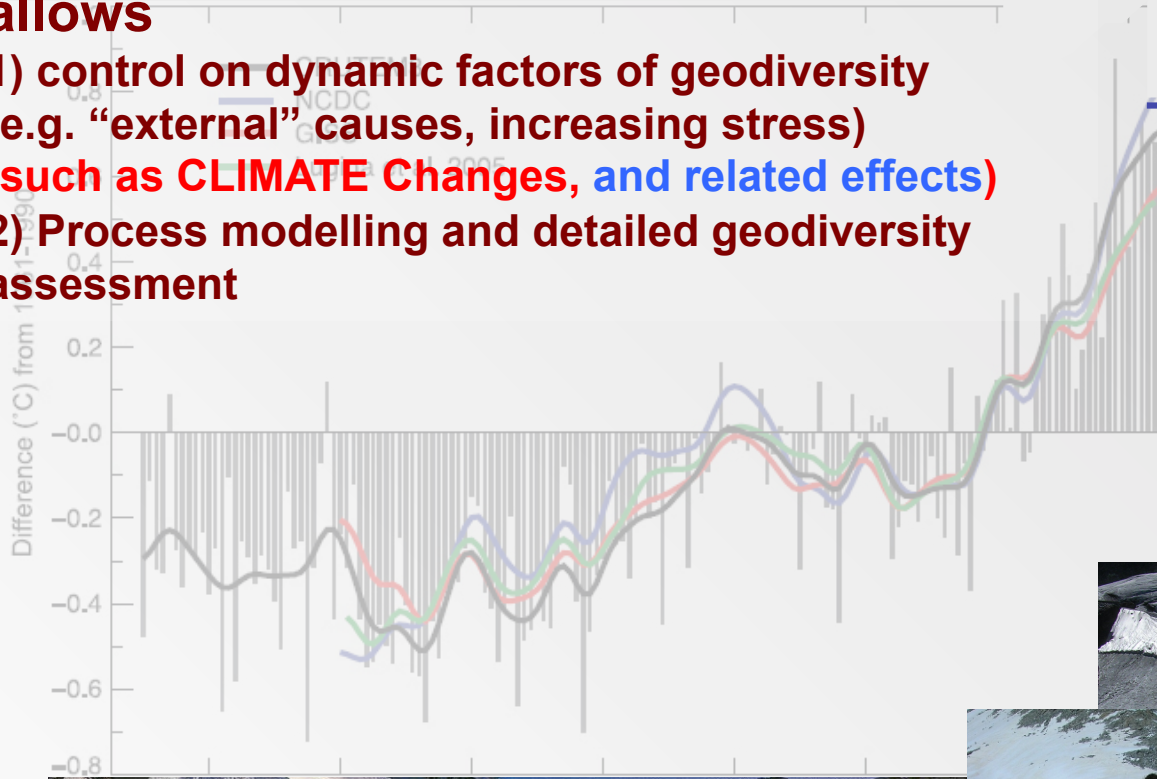
**EROSIONAL  
DEEPENING**



# LOCAL MORPHODYNAMIC APPROACH

allows

- 1) control on dynamic factors of geodiversity (e.g. “external” causes, increasing stress) (such as CLIMATE Changes, and related effects)
- 2) Process modelling and detailed geodiversity assessment



17.07.2006 11:58

# Historical LMA on Cultural Landscapes of mountains

## Past

*Concepts on  
landscape along  
the centuries*



cosa  
perderebbe la natura se  
non un peso che grava  
inutilmente sulla Terra?"

- Petrarca writing *“Ascent to Mount Ventoux”*, France (1336)
- Leonardo da Vinci painting – *“Landscape with river”* (1473)
- Rubens painting: il *“Landscape with rainbow”* (1636)
- Alexander von Humboldt (1807), studies and definitions: *“Landscape as the whole character of a territory...”*
- Goethe wrote *“Travel to Italy”* (1828)
- Carl Troll (1939) introduces new discipline: *“Landscape Ecology”*
- in Italy a law was introduced in 1939 for preserving landscapes as *“natural beauties”* (*“bellezze naturali”*) with only aesthetic purposes...

# LMA: recognize landscape dynamics.... through history



San Leo Rock Falls (Apennines, Italy ) 1: Mingucci watercolor (1626). 1a: “Porta di Sotto” gate; 1b: drawbridge; 2: large fallen rock portions (compared to today); 3: current cliff edge; 4:disappeared city district



# LMA of Landscape

## Present

*Dicotomy...*

*The term landscape is of common use to denote the set of characters that we perceive in an environment...*

*often interpreted only with a "view" of "aesthetic content".*

European landscape convention (2000)

- "Landscape" means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors
- The European Landscape Convention was adopted by the Committee of Ministers of the Council of Europe on 19 July 2000 in Strasbourg and opened to signature by Member States in Florence (Italy) on 20 October 2000. It aims to promote European landscape protection, management and planning and to organise European cooperation.

*Is landscape a form of the environment?*



## Landscape management and Geoparks

In a perspective of sustainable development, it means actions ensuring the landscape “government”, in order to guide and harmonize changes brought by the processes of social development, economic and environmental



## Landscape as a resource...

UNESCO Convention on World Heritage, 1972

**Cultural landscapes:** the product of the combined action of man and nature and their changing relationship over time, under the influence of internal and external forces.

This results in:

**resources, risks (natural, man-made) - research, management, protection**

Unesco World Heritage, 2014



**The Vineyard Landscape of Piemonte: Langhe-Roero Hills**

**Our landscape, due natural and cultural reasons is rich and "diverse"**  
"local landscapes" must be protected, as fundamental values of our culture and as memories of the dialectical relationships between man and nature..

