

Paris 2013: « Geomorphology and Sustainability »

8th IAG International Conference on Geomorphology, August 2013

Session S15C: Managing Landscape Dynamics in Protected Areas

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Protected areas are a leading global conservation strategy, but are not static “sanctuaries” devoted only to nature conservation. They are dynamic areas where both natural processes and the interactions of people and nature are fundamental to their values, and to devising effective strategies for conservation. Understanding the natural processes involved in the evolution of landscapes and the human influences shaping changes in those protected areas, and in their surroundings, is essential. Natural and man induced landscape dynamics in protected areas need to be recognised, monitored and managed in order to ensure effective protection is delivered, and to realise sustainable development that benefits local communities, through activities such as tourism.

In this session papers concerning the following topics are particularly welcome:

- **natural processes in protected areas;**
- **man induced processes in protected areas;**
- **hazard and risk management in protected areas;**
- **strategies of monitoring landscape dynamics in protected areas;**
- **conservation of geomorphological features and processes;**
- **effective protection and management strategies for protected areas;**
- **geomorphological perspectives on vulnerability of cultural heritage;**
- **contribution of geomorphological approaches to conservation of biodiversity and cultural heritage.**



GEOHERITAGE AND GEOTOURISM MAPPING VERSUS GEOMORPHOLOGIC MAPPING: SCALE AND SYMBOL ISSUES



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Geoheritage and geotourism maps are (as **geomorphologic maps**), **earth science thematic maps applied** to research and diffusion of results.

So, although the **questions related to the construction of the geoheritage and geotourism maps**, namely those concerning the **scale and legend** of the maps, **are not yet been properly discussed**, there are not many things to be “invented”.

Why?

Because to build geoheritage and geotourism maps we need **information from 2 available domains: 1) earth science information** (mainly geologic, geomorphologic and hydrologic) that normally we can get from a **geomorphologic detailed map**; **2) cartographic information** about **what is a thematic map**, what should be put in the **base** and in the **content of the map**, the **properties of the symbols** and **relations with the scale, levels of legibility**, etc.

If these 2 domains of research needed to build up geoheritage and geotourism are already developed, why there are still problems with the application of several principles in the construction of the maps?

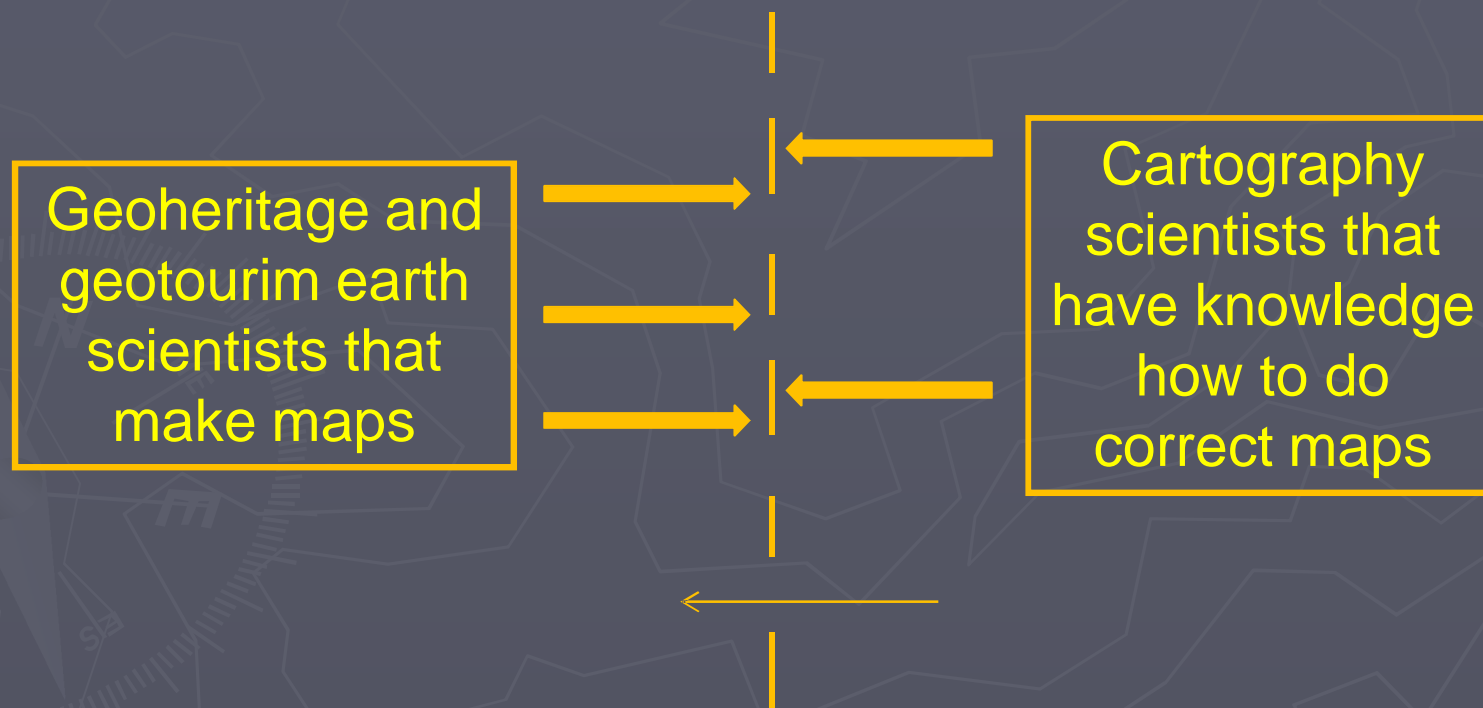
Due to 2 types of problems:

1) The **geoheritage and geotourism maps** are made by **earth scientists** that have **no specific formation in cartographic sciences** (such as perception theories and legibility studies, analysis of human responses to symbols and complex contents, etc.). At the same time **cartography scientists usually do not devote its skills applied to earth science maps.**

2) Some **earth science researchers seem to ignore the efforts already made in the field of geomorphologic mapping** did mainly in the **60's and 70's** of the XX century, **but also today**, namely by the **IAG WG on Applied Geomorphological Mapping** (Smith, Paron & Griffiths, 2011) .

1st PROBLEM:

Geoheritage and geotourism maps are made by earth scientists that have no specific formation in cartographic sciences and cartography scientists usually do not devote its skills applied to earth science maps.



Not a very permeable frontier

How to solve this 1st problem?

Those that made the geoheritage and geotourism maps (**earth scientists**) have to gether information and skills about cartography issues.

Such as:

- **“families” of thematic maps;**
- **concept of cartographic symbol** (points, linear, areal, figurative, abstract, proporcional, geometric, etc.);
- **visual variables** (size, value, texture, colour, orientation, form);
- **perceptive properties of the symbols** (selectivity, associativity, order, value, etc.);
- **spacial suport of the thematic map** and its relation with the potencial users;
- the **scale of the map** - relations with the **content** of the map and with the type of the **cartographic generalization**: structural (small reductions) or conceptual (medium and strong reductions), etc.

How to solve the 2nd problem?

- **Those that made the geoheritage and geotourism maps (earth scientists) have to be informed about the scientific works done in the field of geologic and geomorphologic mapping.**
- About geomorphologic mapping a lot have been done mainly in the **60's and 70's** of the XX century (see, for instance, Klimaszewski, 1968; Demek, 1972; Demek & Embleton, 1976), **but it is also being done today**, namely by the **IAG WG on Applied Geomorphological Mapping** (see Smith, Paron & Griffiths, 2011).
- The discussion about scales and legends has been long, arduous and exhaustive. A lot of publications show the main results. Although there was not a total consensus about these issues, **there was an agreement about some main questions**, for instance those related to the **types of map scales**.

The question of the map scales

- There is **no reason to adopt different criteria** for the geoheritage and geotourism maps **from those adopted for the geomorphologic maps** (also thematic maps).

Adopted from Demek (1972), *Manual of detailed geomorphological mapping* :

- **Geomorphologic Plans – up to 1:10 000**
- **Large Scale Geomorphologic Maps - 1:10 000 to 1:50 000** (excepcionally 1:100 000)
- **Medium Scale Geomorphologic Maps – 1:50 000/1:100 000 to 1:500 000**
- **Small Scale Geomorphologic Maps - 1:500 000 to 1:1 000 000**
 Geomorphologic Maps of countries - 1:1 000 000 to 1:5 000 000
 Geomorphologic Maps of continents - 1:5 000 000 to 1:30 000 000
 Geomorphologic Maps of the Earth - 1:30 000 000 and lower scales

However, as **since then** there has been a **need to do even more detailed geomorphologic maps**, we made small adjustments to this classification.

Classification of geomorphologic map scales from Rodrigues (1998):

- **Geomorphologic Plans - up to 1:2000**
- **Detailed Geomorphologic Maps - <1:2000 up to 1:10 000**
- **Large Scale Geomorphologic Maps - <1:10 000 up to 1:25 000 or 1:50 000**
- **Medium Scale Geomorphologic Maps - <1:50 000 up to 1:500 000**
- **Small Scale Geomorphologic Maps - <1:500 000 up to 1:1 000 000**

Of course **the scale that should be used** to do a **geoheritage or geotourism map** depends on the **objectives** of the map.

However, **what are the positions about the scale of these maps?**

- **Carton, Coratza & Marchetti (2005)** – 1st approach to the question of scale in geomorphologic sites mapping. They **fix the limit** between the so called **small scale maps (less than 1:200 000)** and the **large scale maps (greater than 1:200 000)**. **WHY?** Because they say so!!!

- More recently, **Coratza** (also co-author of the previous paper) & **Regolini-Bissig (2009)** refer **medium and large scale geomorphosite maps** (giving as example two maps at **1:25 000 and 1:12 500 scales**) and **small scale maps**. However, there is no discussion about scale and it is even written that the **working scale can be international, national, regional or local**.

Conclusion

In the specialized literature **there are no information about the scales to be used in geoheritage and geotourism maps** and there **confusions between scale and symbols**, although the two things are connected.

The question of the map symbols

- There is **no reason to adopt different criteria** for the geoheritage and geotourism maps **from those adopted for thematic maps**.
-

Everybody agree that we can use **point, line or area symbols**.

In the **maps of points** we can use only **dots** or **introduce the size to express value** (area or volume proportional to the value, i.e., $A=V$ for a representation using proportional circles, better that use spheres).

We can do the same for the **maps of lines** (using **different thicknesses of the lines**).

There are **big problems** with the **use of color** and of **symbols with different shapes**, that are the **2 techniques more used** in the geoheritage and geotourism maps.

Color problems:

- there are **subjective concepts** of colors from person to person;
- the **primary colors do not give an order**;
- there are **conventional colors** used for certain purposes (hypsometric colors, temperature maps, precipitation maps, Munsell colors, etc.);
- problems due to **deficiencies of (chromatic) vision**;
- etc., etc.

Symbols with different shapes:

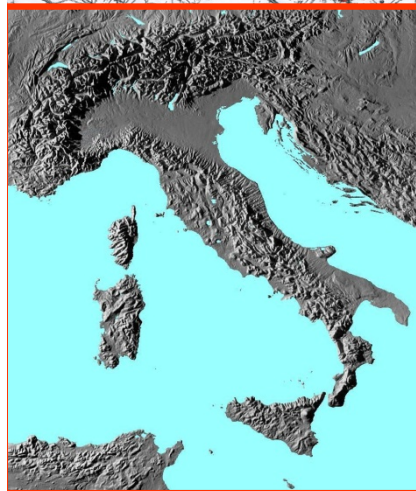
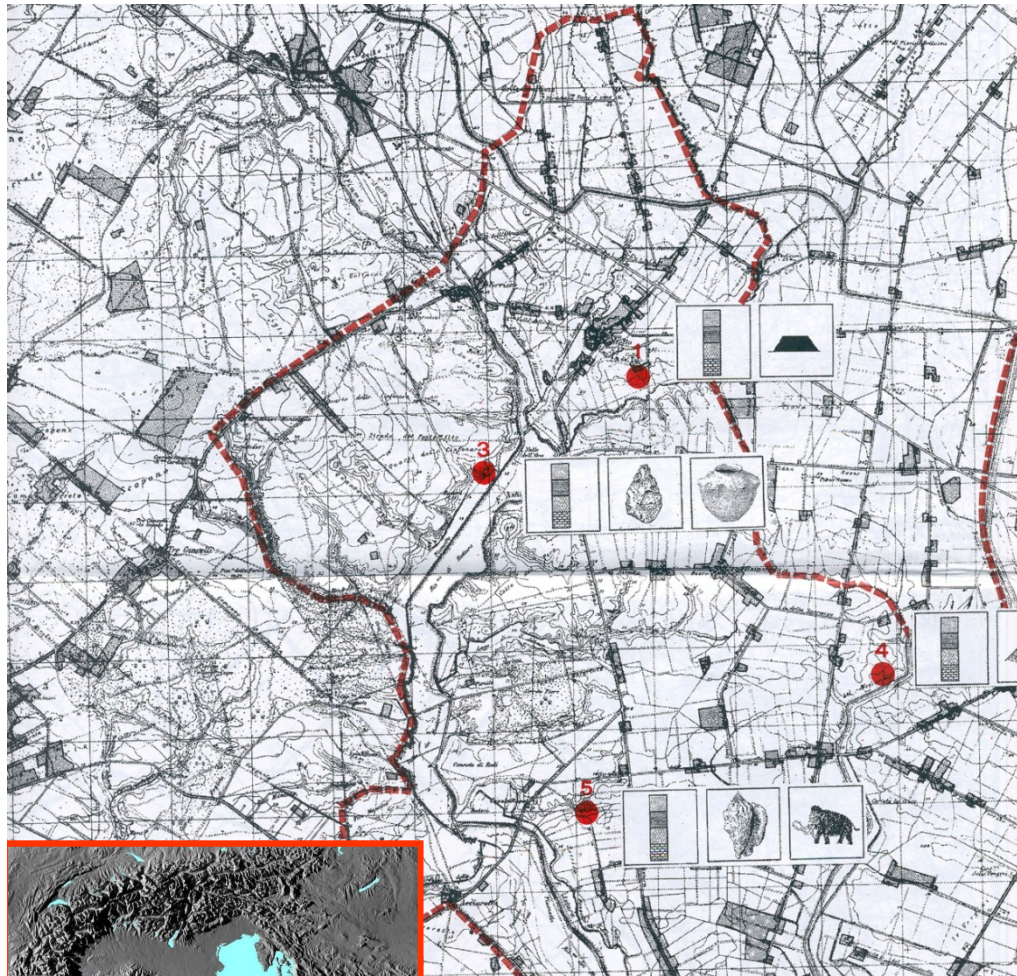
- **quite used** to represent the geosites, **can be figurative/pictorial** (fossil, cave, mineral, etc.), that are difficult to draw, **or abstract** using **points, squares, triangles, stars, flags and many other symbols that you can imagine...**

Result: we cannot read the hole map neither do our target public!!! Why? We can only “read” and compare the spatial distribution of a type of symbol each time.

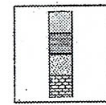
Some examples of geoheritage and geotourism maps



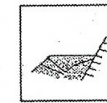
Casto L., Zarlenga F.(1990) - *Carta dei Beni Culturali a carattere geologico. La Pianura Pontina, Fontana, e i Monti Ausoni meridionali.*



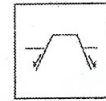
GEOLOGIA
(Geology)



Stratigrafia
Stratigraphy



Terrazzo marino
Marine terrace



Alto strutturale
Structural high ("Horst")



Cava
Quarry



Faglia
Fault

PALEONTOLOGIA
(Palaeontology)

GEOMORFOLOGIA
(Geomorphology)



Invertebrati
Invertebrates



Carsismo
Karst



Vertebrati
Vertebrates

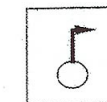


Grotta
Cave

IDROGEOLOGIA
(Hydrogeology)

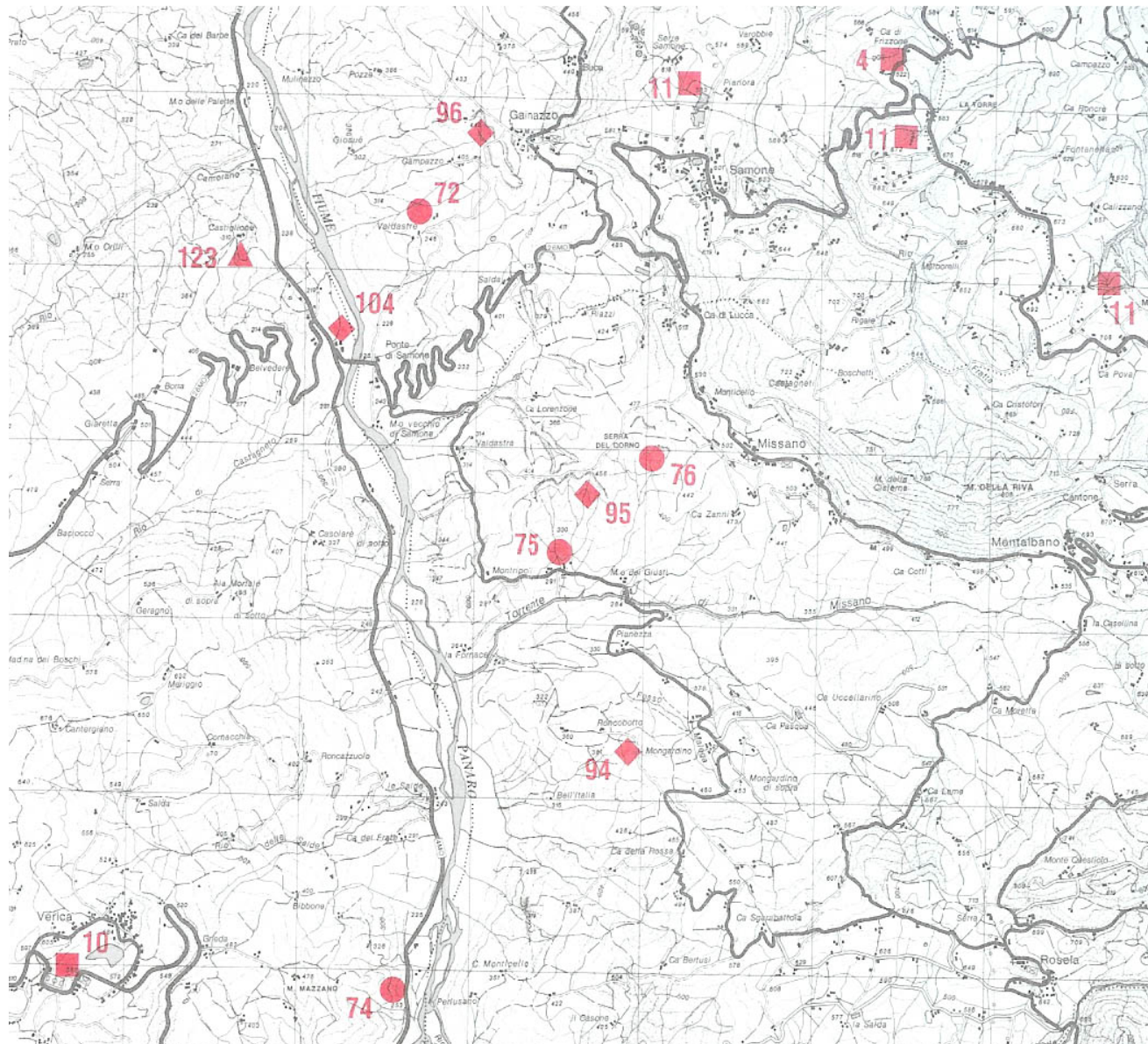


Duna
Dune



Sorgente
Spring

From D. Castaldini - *Intensive Course* - "Geosites: methodology, recognition and mapping, as natural resources for the tourist valorization", Lisbon, May 2012



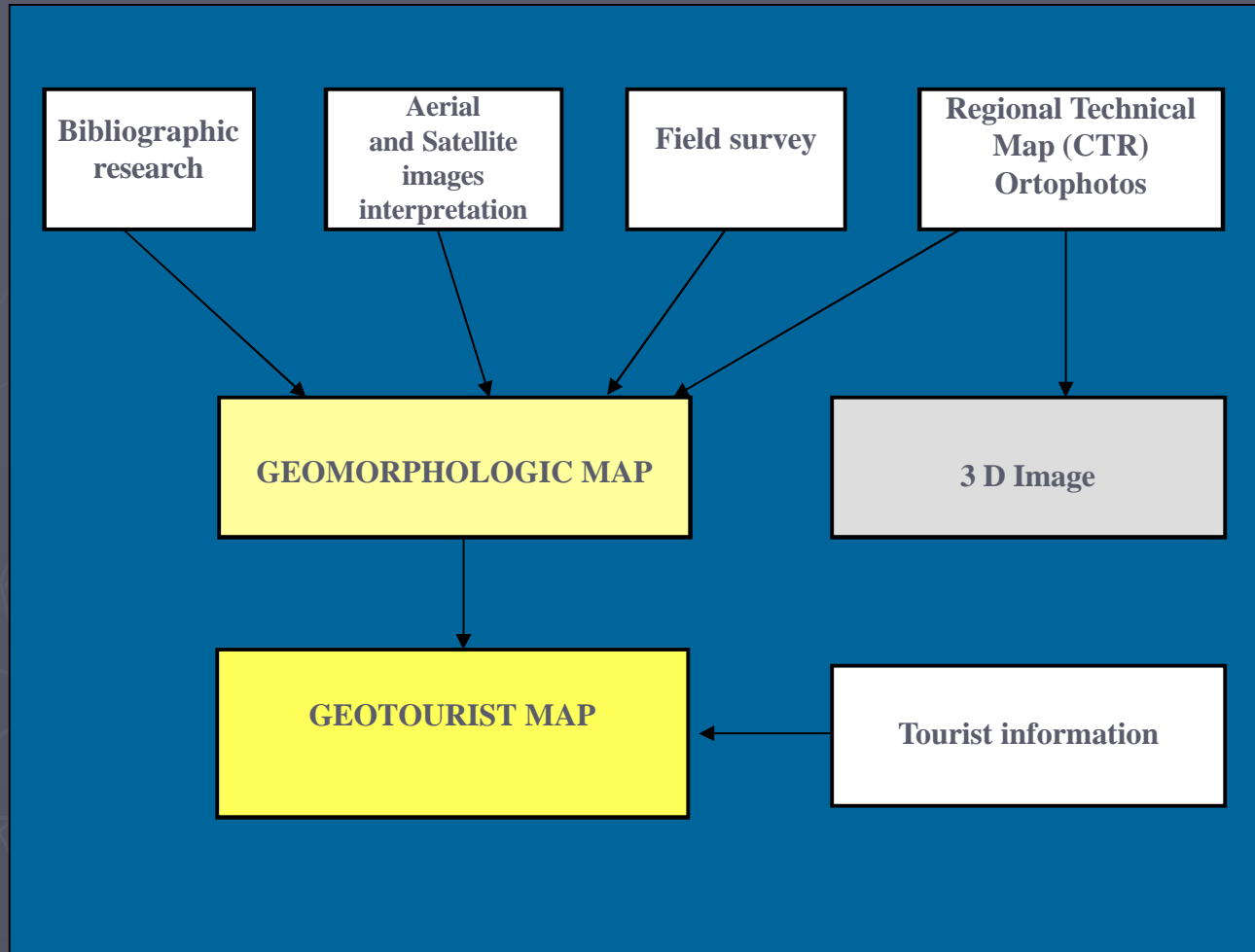
- Square: geomorphology
- Rumble: mineralogy
- Circle: cave
- Triangle: stratigraphy

Bertacchini M., Giusti C., Marchetti M., Panizza M., Pellegrini M. (eds.) (1999) – *I beni geologici della Provincia di Modena*. Artioli Editore, Modena.

From D. Castaldini - *Intensive Course* - “Geosites: methodology, recognition and mapping, as natural resources for the tourist valorization”, Lisbon, May 2012

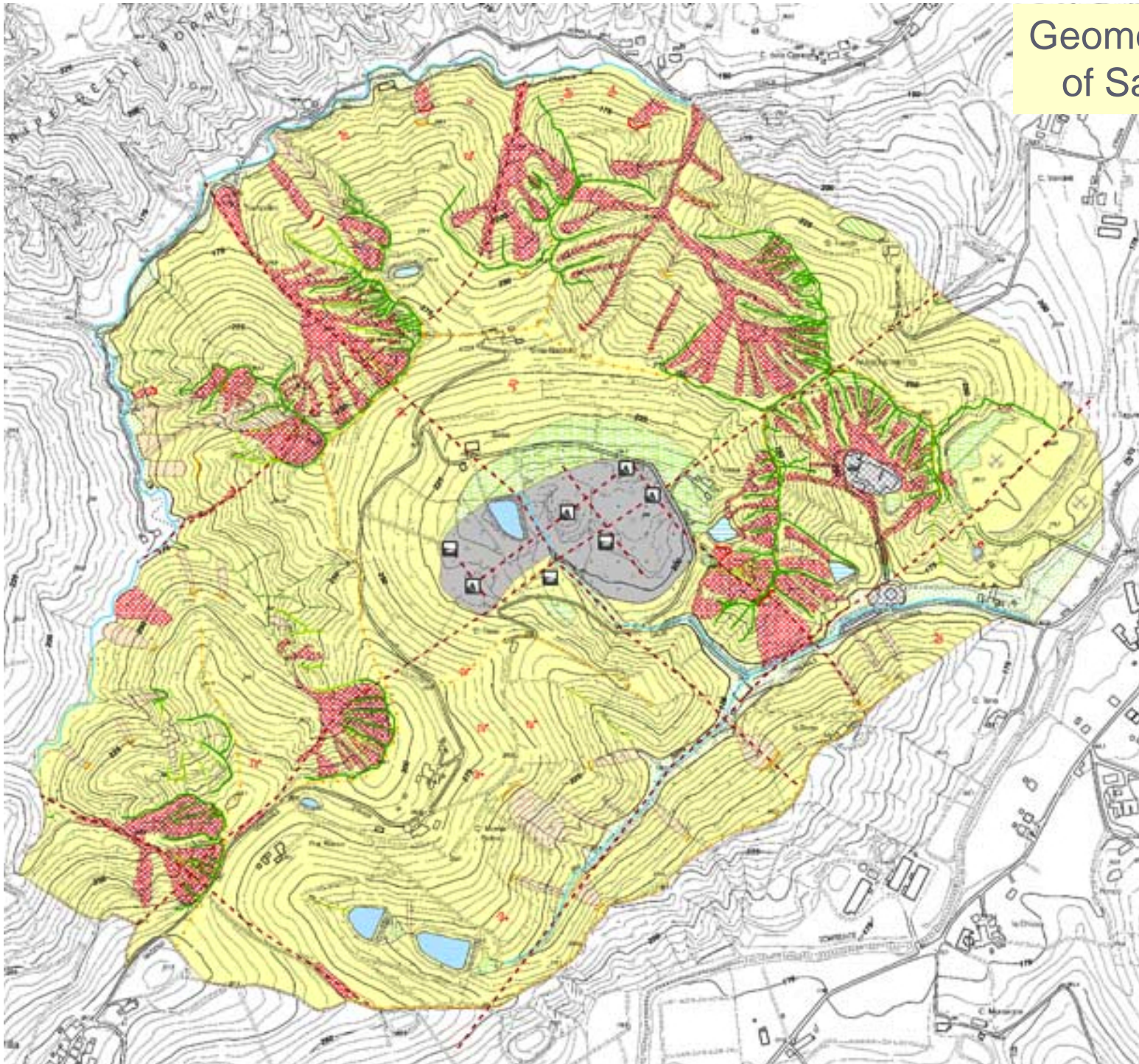


Method of study of the Touristic-Ambiental Maps (Castaldini)




CASTALDINI D., CONVENTI M., CORATZA P., DALLAI D., LIBERATOSCIOLI E., SALA L. & BULDRINI F. (2011) – Carta Turistico - Ambientale della Riserva Naturale Regionale delle Salse di Nirano.

Geomorphologic map of Salse di Nirano



LITOLOGIA DEL SUBSTRATO (BEDROCK LITHOLOGY)

-  Argille debolmente marnose, localmente siltose, grigio azzurro a stratificazione mal distinguibile; locali intercalazioni di sabbie fini in strati sottili o medi (Argille azzurre, Pliocene inferiore - Pleistocene inferiore)
Maily-clays, locally silty-clays, greyish blue with bad stratification; locally fine sandy layers interbedded (Argille azzurre Lower Pliocene - Lower Pleistocene)

DATI STRUTTURALI (STRUCTURAL DATA)

-  Limite litologico
Lithologic boundary
-  Faglia/frattura presunta
Assumed fault/fracture

IDROGRAFIA (HYDROGRAPHY)

-  Corso d'acqua principale
Main stream
-  Laghetto
Pond
-  Palude
Marsh

FORME E DEPOSITI LEGATI AL FENOMENO DELLE SALSE (LANDFORMS AND DEPOSITS RESULTING FROM THE "ENDOGENETIC" ACTIVITY)

-  Salsa o gruppo di salse a cono
Cone-shaped mud volcano or group of cone-shaped mud volcanoes
-  Salsa o gruppo di salse a poia
Level-pool mud volcano or group of level-pool mud volcanoes
-  Depositi di colata delle salse
Mud-flow deposits of mud volcanoes









FORME POLIGENETICHE (POLYGENETIC FORMS)

-  Crinale, cresta, spartiacque
Ridge, crest, watershed

FORME ANTROPICHE (ANTHROPOGENETIC LANDFORMS)

-  Area intenzionalmente modellata
Heavily shaped area
-  Area di cave dismesse
Abandoned quarry area
-  Orlo di scarpata artificiale
Edge of artificial escarp
-  Terrapieno
Landfill

FORME E DEPOSITI PER ACQUE CORRENTI SUPERFICIALI (LANDFORMS AND DEPOSITS DUE TO RUNNING WATERS)

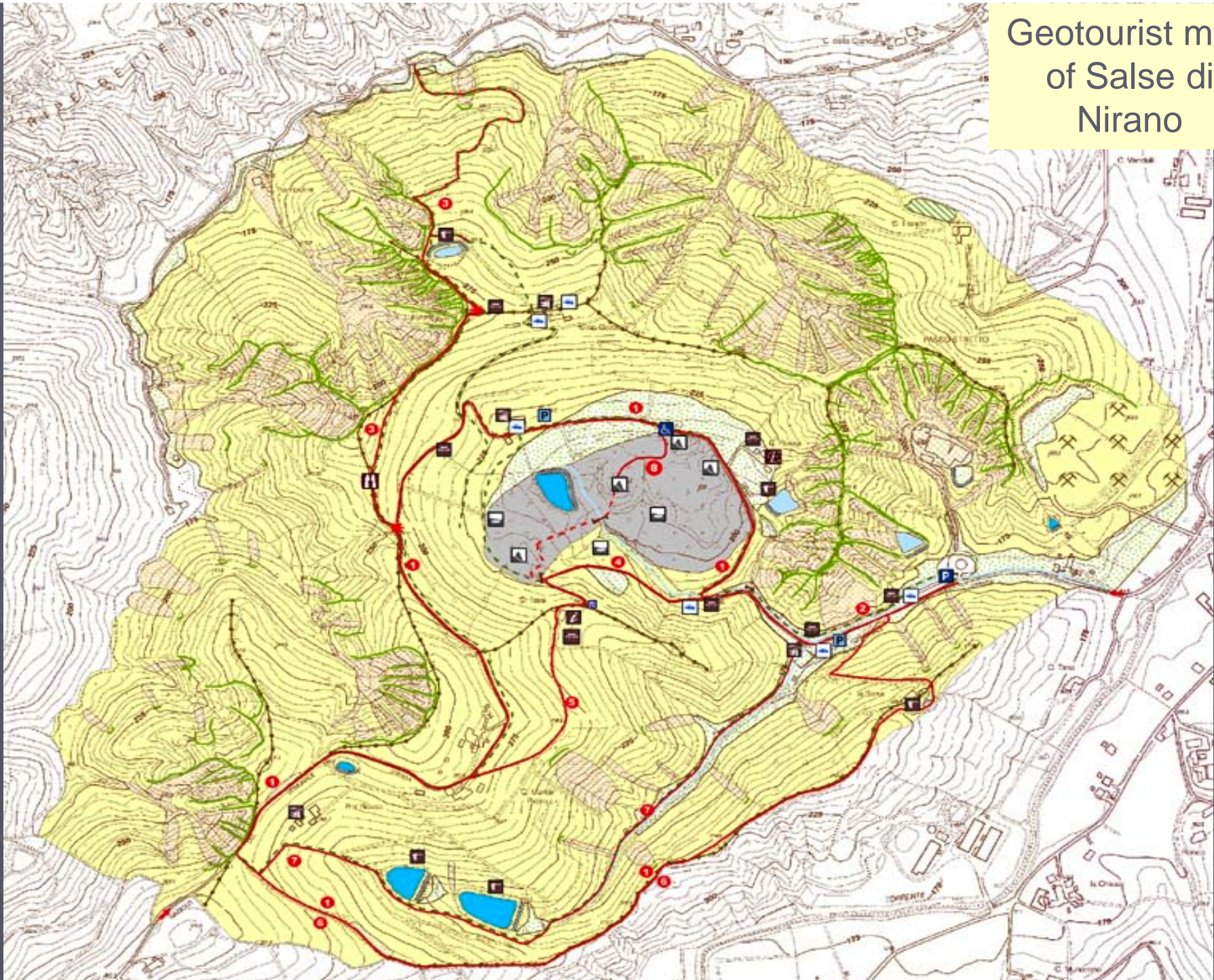
- | Attivo (Active) | Quiescente (Dormant) | |
|---|---|--|
|  |  | Orlo di scarpata di calanco
Edge of basaltic escarp |
|  |  | Soko da ruscellamento concentrato
Gully |
| |  | Depositi dei corsi d'acqua principali (Tessitura dalle sabbie alle argille, spessore > 1 m)
Deposits of the main streams (Texture from silt to clay, more than 1 m thick) |
|  |  | Depositi colluviali (Tessitura dai limi alle argille, spessore > 1 m)
Colluvial deposits (Texture from silt to clay, more than 1 m thick) |
| |  | Depositi paludosi (Tessitura prevalentemente argillosa, spessore > 1 m)
Palustrine deposits (Texture mainly clayey, more than 1 m thick) |

FORME E DEPOSITI GRAVITATIVI DI VERSANTE (SLOPE LANDFORMS AND DEPOSITS DUE TO GRAVITY)















- | Attivo (Active) | Quiescente (Dormant) | |
|---|---|--|
|  |  | Orlo di scarpata di degradazione o di frana
Edge of degradational and/or landslide escarp |
|  |  | Frana (per colata e/o sconvolgimento)
Landslide (flow type) |
|  | | Area interessata da soliflusso
Slope affected by solifluction |

Legend of the Geomorphologic map of Salse di Nirano

Geotourist map
of Salse di
Nirano



ASPETTI GEOLOGICI E GEOMORFOLOGICI
GEOLOGICAL AND GEOMORPHOLOGICAL CHARACTERISTICS

	Argille di origine marina Pliocene inferiore - Pleistocene inferiore <i>Marine clays</i> <i>Lower Pliocene - Lower Pleistocene</i>
	Depositi di colata fangosa delle salse <i>Mud-flow deposits of mud volcanoes</i>
	Salsa o gruppo di salse a cono <i>Cone-shaped mud volcano or group of cone-shaped mud volcanoes</i>
	Salsa o gruppo di salse a polla <i>Level-pool mud volcano or group of level-pool mud volcanoes</i>
	Depositi per acque superficiali <i>Deposits due to superficial waters</i>
	Frana <i>Landslide</i>
	Orlo di scarpata di calanchi e/o di frana <i>Edge of badlands scarp and/or landslide scarp</i>
	Crinale, spartiacque <i>Ridge, watershed</i>
	Corso d'acqua principale <i>Main stream</i>
	Laghetto <i>Pond</i>
	Zona umida <i>Marsh</i>
	Area produttiva dismessa <i>Disused farming area</i>
	Argine artificiale <i>Artificial embankment</i>
	Area di cava dismessa <i>Abandoned quarrying area</i>

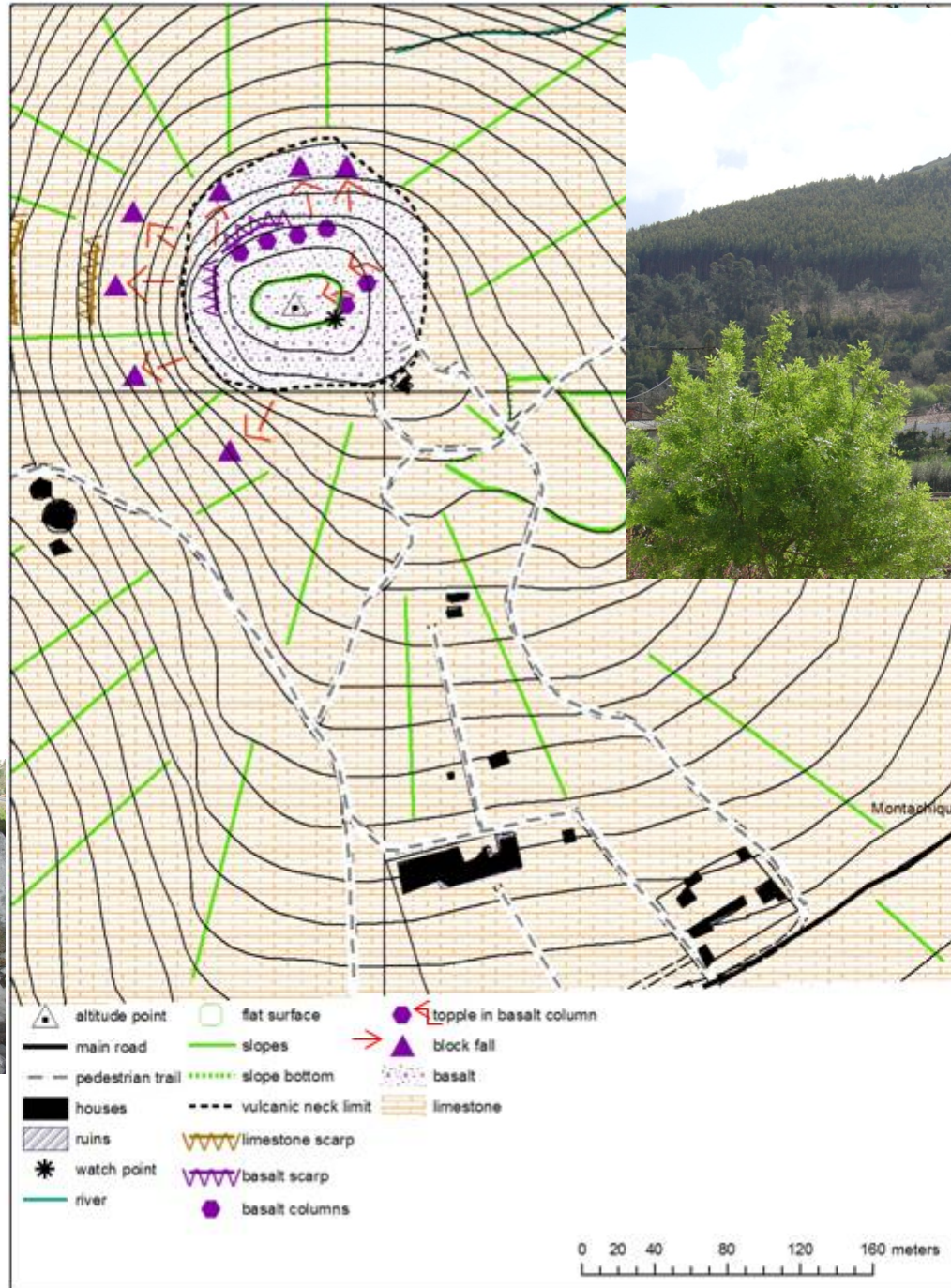
INDICAZIONI TURISTICHE
TOURIST INFORMATION

	Centro Visite Cà Tassi <i>Cà Tassi visitor centre</i>
	Ecomuseo Cà Rossa <i>Ecomuseum Cà Rossa</i>
	Stazione meteorologica <i>Meteorological station</i>
	Strada di accesso principale <i>Main road</i>
a)  b)  c) 	Area di parcheggio: a) pubblico; b) per disabili; c) privato <i>Parking area: a) public; b) handicap; c) private</i>
	Percorso escursionistico <i>Excursion trail</i>
	Percorso didattico con bacheche illustrative: <i>Educational trail with educational panels:</i>
	Percorso Le api e la biodiversità Percorso La flora spontanea e le specie protette Percorso Acqua in tutte le salse Percorso Gusti memorabili
a)  b) 	Punto di osservazione: a) panoramico, b) con binocolo <i>Observation point: a) panoramic, b) with binoculars</i>
	Ponte pedonale <i>Pedestrian bridge</i>
	Fontana <i>Fountain</i>
	Area di sosta attrezzata <i>Picnic area</i>
	Osservazione avifauna <i>Birdwatching</i>
	Luogo di ristoro e/o pernottamento <i>Refreshment and overnight-stay site</i>

Legend of the Geotourist map of Salse di Nirano

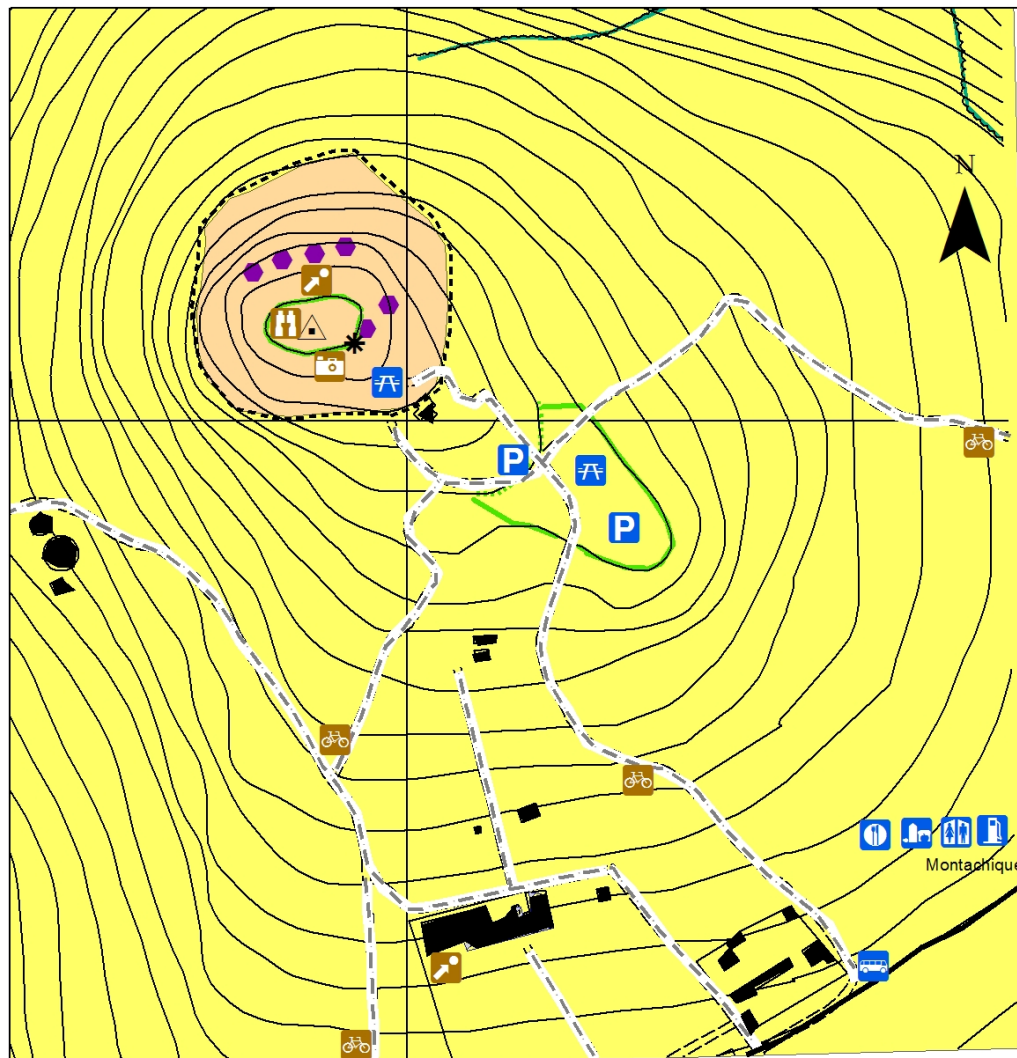
One of several **vulcanic necks** located North of Lisbon. These bodies were responsible by the **Lisbon Vulcanic Complex** from the **Upper Cretaceous**.

Geomorphologic map of Cabeço de Montachique

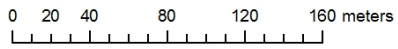


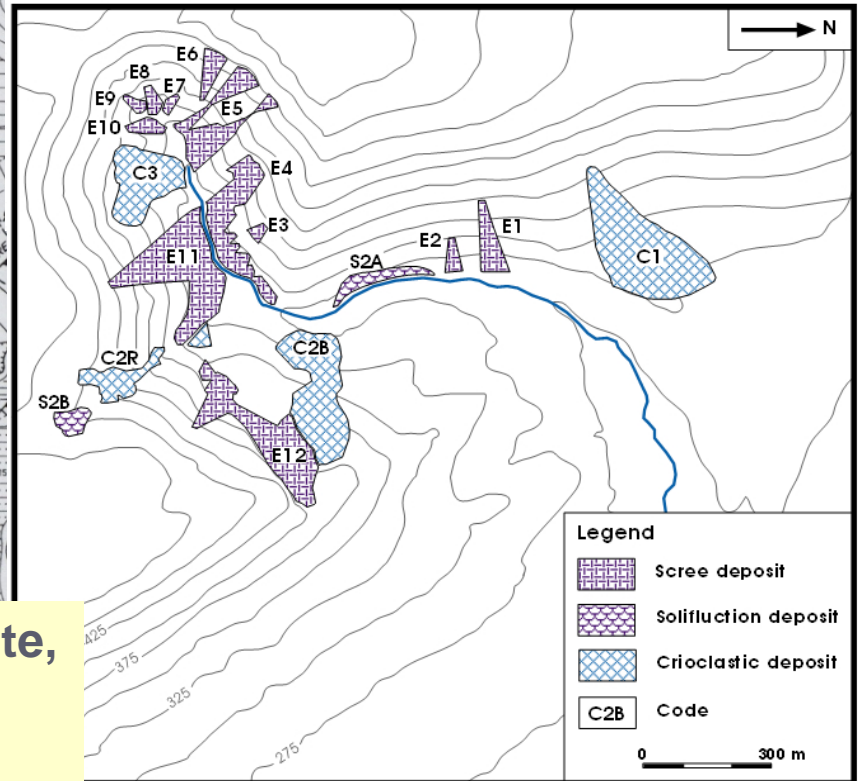
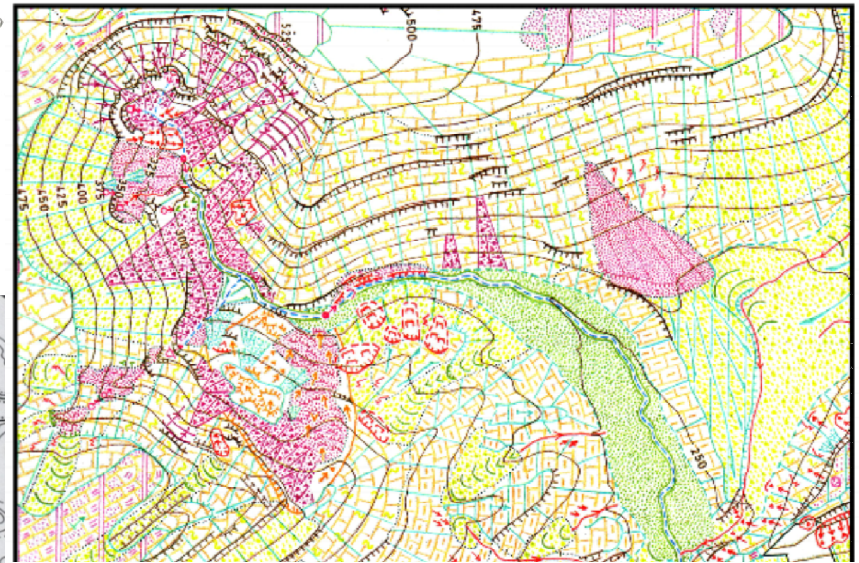
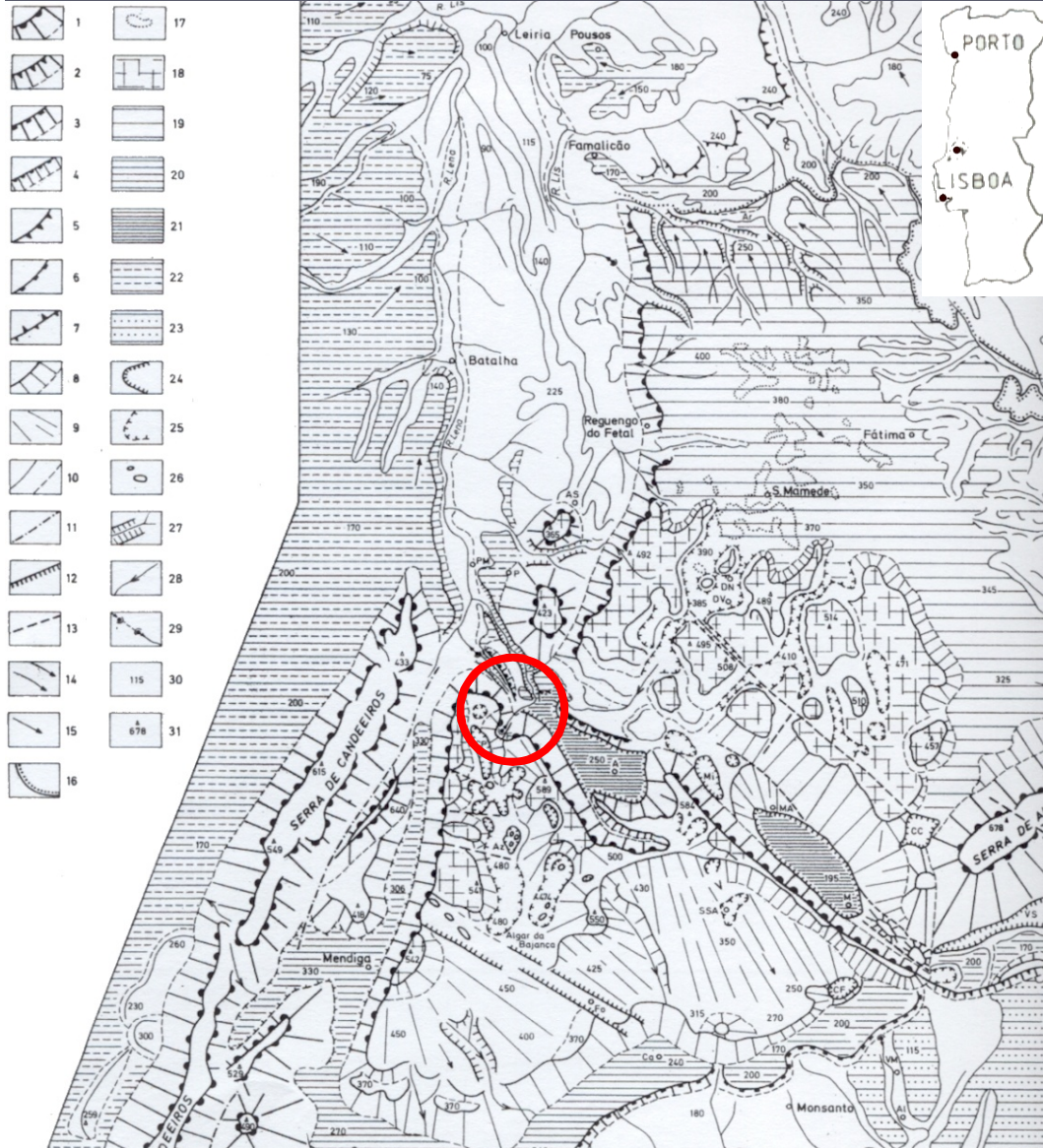
Basalt columns

Geoturistic map of Cabeço de Montachique



	bus stop		interest point		ruins
	parking		btt trail		watch point
	wc		viewing area		river
	coffee shop		photo spot		flat surface
	restaurant		altitude point		vulcanic neck limit
	gasoline station		basalt columns		basalt
	picnic area		main road		limestone
			pedestrian trail		
			houses		





Crionival deposits in the Forna geomorphosite, Estremadura Limestone Massif, Portugal (ML Rodrigues, 2010)

Legend	
	Scree deposit
	Solifluction deposit
	Crioclastic deposit
	Code
0 300 m	