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2015 International Year of Soils

Field trip on soils: Soil information for the sustainable development in mountainous areas

Field Guide. Soil information for the sustainable development of mountain areas: Pallars Jussà Region (Dellà and Tremp Basins)

Institut Cartogràfic i Geològic de Catalunya (ICGC)

Barcelona, June 2015

The contents of this guide have been mainly taken from the following monographs:

- *TRANSCATALONIA 2014: Pallars Jussà Region (Dellà and Tremp Basins), published by the Institució Catalana d'Estudis Agraris (ICEA) i Delegació Catalana de la Sociedad Española de la Ciencia del Suelo (SECS).*

- *"Mapa de Sòls de Catalunya a escala 1:250.000, Pallars Jussà", published by the Institut Cartogràfic I Geològic de Catalunya.*

- *"The Soil Study for the municipality of Isona, scale 1:25.000", both published by Institut d'Estudis Catalans and the Institut Cartogràfic I Geològic de Catalunya.*

SUMMARY OF THE PROGRAMME

- *Geographical and Geological panoramic of the area (Viewpoint at Port de Comiols).*
- *Covet. Soils developed on conglomerates debris.*
- *Map of Sianes (Isona) Vertic Soil.*
- *Basturs Ponds. Visitation of the ponds and hydrogeological explanation.*
- *Basturs Pond. Profile for travertine Soils.*
- *Nerets Mountain Range. Red clays from quartzarenite alterations of the Areny set calcium cement.*
- *Guided visit to the IGCC's Pyrenean Territory Support center.*
- *Talarn, Sant Miquel. Soils over conglomeratic alluvial fan.*
- *Sant Salvador de Toló. Calcareous lacustrines and Soils over clay deposits.*

TABLE OF CONTENTS

1. INTRODUCTION

Our planned itinerary for the Pallars Jussà's edaphological field trip is based on the data obtained from two studies done in recent years in this region. To be more precise, these are the Soil Study of the area of Isona map at 1:25.000 scale and the realization of the 1:250.000 scale map of the Pallars Jussà region. Both works highlight the great variability in this region soils, which also can be linked to the richness of the several landscapes found in the area.

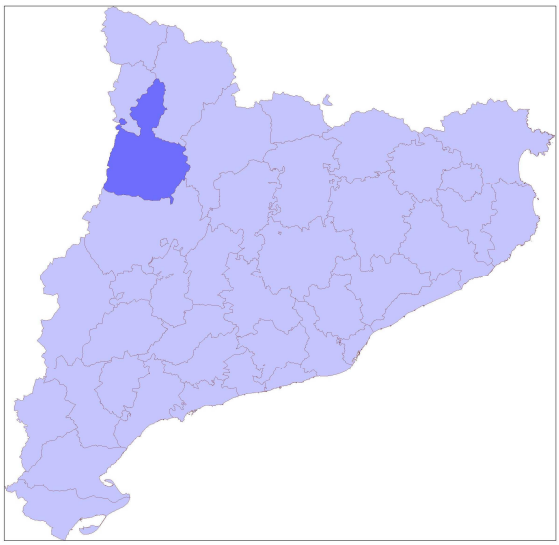
This field trip is proposed with the ultimate intention of showing this variability by means of taking a walk through those different environments, in what practically will be a circular trip. The starting point of it will be the Port de Comiols, a magnificent spot to enjoy a panoramic view of the Dellà Basin, where most of our trip will be happening. We will visit Covet, Isona, Basturs and els Nerets, near Vilamitjana. From there, we will start to climb towards the Gurp mountain range to finally retake the path leading back to Comiols, making a last stop at a singular spot near Sant Salvador de Toló.

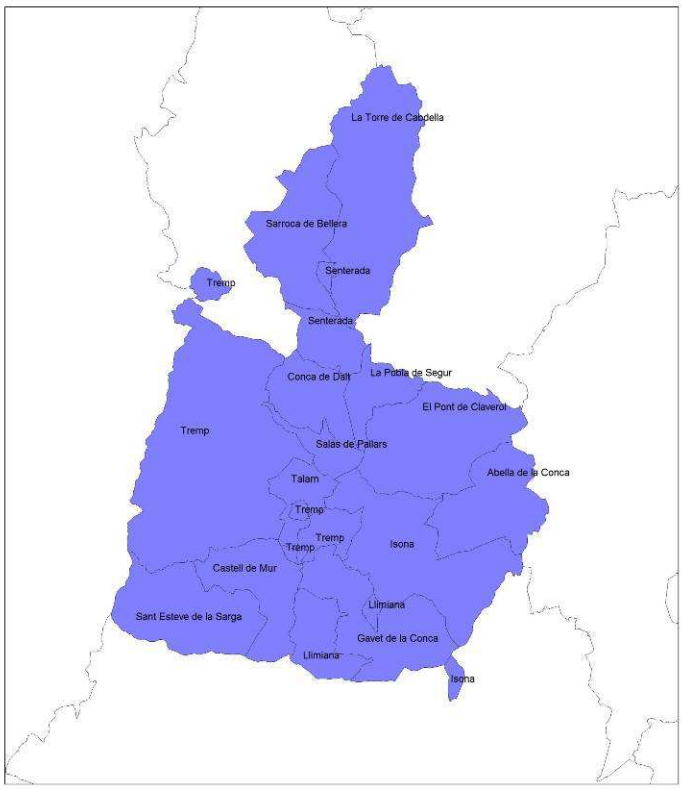
Bearing in mind the great variability that can be found in the area, we have tried to single out some amongst the most representative soils in this region.

We wish that you find this field trip interesting and that it will help you to create an approximate mental picture of the complexity of the studied area, both at geological and edaphological levels.

2. GEOGRAPHICAL LOCATION

The Pallars Jussà region is located in the Lleida province, bordering on Aragon to the west, the Alta Ribagorça and Pallars Sobirà to the north, Alt Urgell to the east and Noguera to the south.





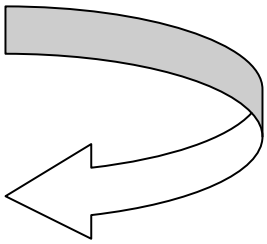


Fig.1 Location of the Pallars Jussà region within Catalonia and municipalities that form it (Source ICGC).

The Pallars Jussà covers an area of 1343.1 km2 and is divided into 14 municipalities, being Salàs de Pallars the one with the lowest surface, with 20,53 km2, and Tremp the largest one, not only in the region but throughout Catalonia, with 301.99 km2. The population density is of 10.2 people per km2, 45% of that population concentrating at the municipality of Tremp and 23% of them at La Pobla de Segur. Specifically, according to the Statistical Institute of Catalunya, Tremp had a population of 6190 in 2008.

Broadly speaking, we can distinguish two main zones, the Fosca Valley in the north, reaching the Pyrenean axial zone, and the Tremp basin in the centre of the region, with a clearly Mediterranean atmosphere, surrounded by two Pre-Pyrenean mountain ranges: San Gervàs, Peracalç and Boumort to the north and the Montsec mountain range to the south. The connection between those different areas happens through two gorges in the north -Erinyà and Collegats, carved by the rivers Flamisell and Noguera Pallaresa respectively- and the gorge of Terradets to the south, which allows the passage of the river to the neighbouring region of la Noguera. To the west of the region, the river Noguera Ribagorçana, already bordering on Aragon, carves through the Montrebei gorge and through the Montsec.

Separating the various sub-basins we find the anticlinal of the Carreu and Sant Corneli mountain ranges, as well as the reliefs formed by conglomerates at the Gurp mountain range. Those first two separate the Dalt (upper) and Baix (lower) basins, which in turn are divided by the Noguera Pallaresa river into the Deçà basin, to the west, and the Dellà basin, to the east. West of the Gurp mountain range we find la Terreta.

3. CHARACTERIZATION OF THE NATURAL ENVIRONMENT

3.1. Land Use

The Pallars Jussà region has a mappable surface of approximately 134,300 ha. According to the territory distribution official statistics of Catalonia, this surface presents the following land uses:

Agricultural: 24,632 ha
Forestry 107,891 ha
Various 1,778 ha

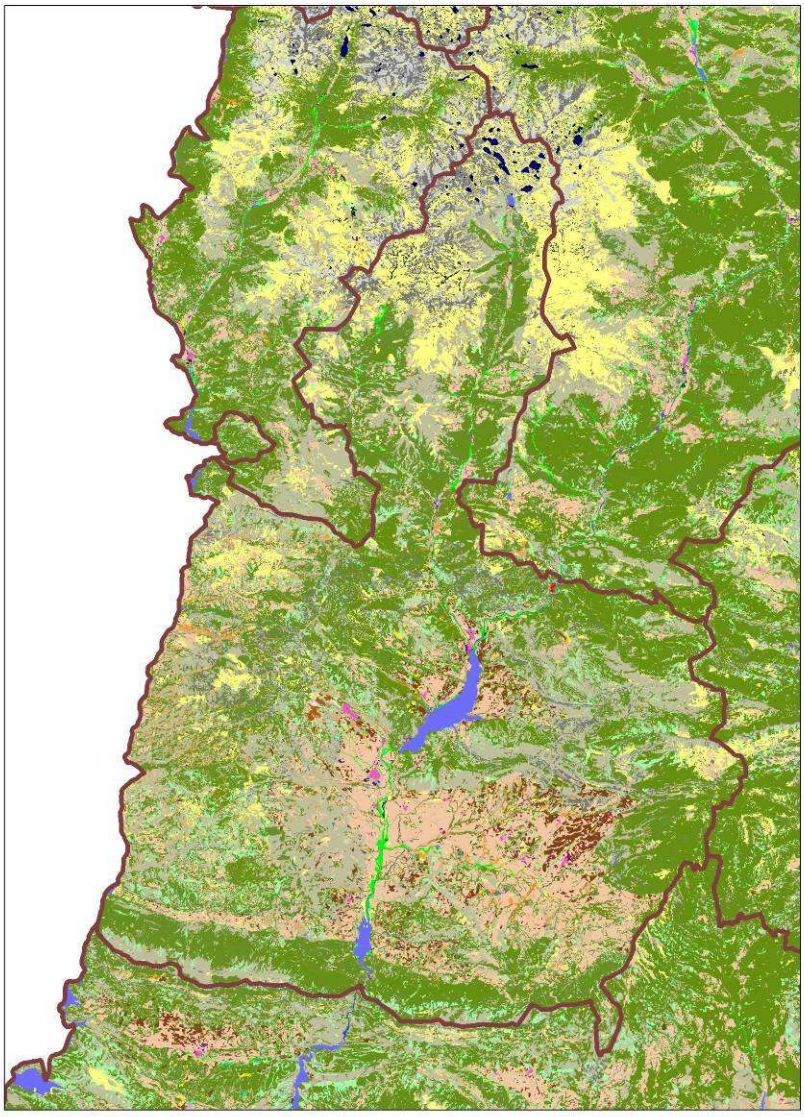


Fig.2 Soil Usage (Source ICGC, taken from the Mapa de cobertes de sòl de Catalunya, CREAF).

Thus, we can say that this region mostly relies on forestry, although from an economical point of view agriculture is more relevant to the region. The agricultural zones are basically concentrated in the outskirts of the main municipalities of the region and in the valleys, near the rivers that cross them. As for crop usage, cereal obviously takes highlight of it, both dryland and irrigated, also alfalfa, traditional almond and olive tree cultivation and lastly, but with a significant growth on the cultivated surface, vineyard areas, as the region has recently been included in the Costers del Segre Denomination of Origin.

3.2. CLIMATE

At a climatological level, variability in the Pallars Jussà region is also quite high. We can find Subalpine climate at the Fosca and Manyanet Valleys and Mediterranean mountain climate at the rest of the areas.

Subalpine climate is characterised by frequent snow precipitation, extreme winter temperatures and mild summer temperatures with remarkable rainfall during summers, although they are more abundant during springtime and autumn. Average rainfall figures fluctuate around 900 to 1250 mm/year. Mediterranean mountain climate is characterised by summers as dry seasons and frequent frost during winters. Average rainfall figures fluctuate around 600 to 800 mm/year. During the colder months, thermal inversion is frequently observed. This clearly influences the altitudinal distribution of the vegetation layers.

The Tremp Basin is the area with the warmest temperatures and least precipitation in this zone. Average pluviometry figures increase and average temperature figures decrease as we get higher in height and as we move from the southern to the northern areas of the region. Thus, the Fosca Valley has the highest pluviometry and the lowest average temperatures of the region.

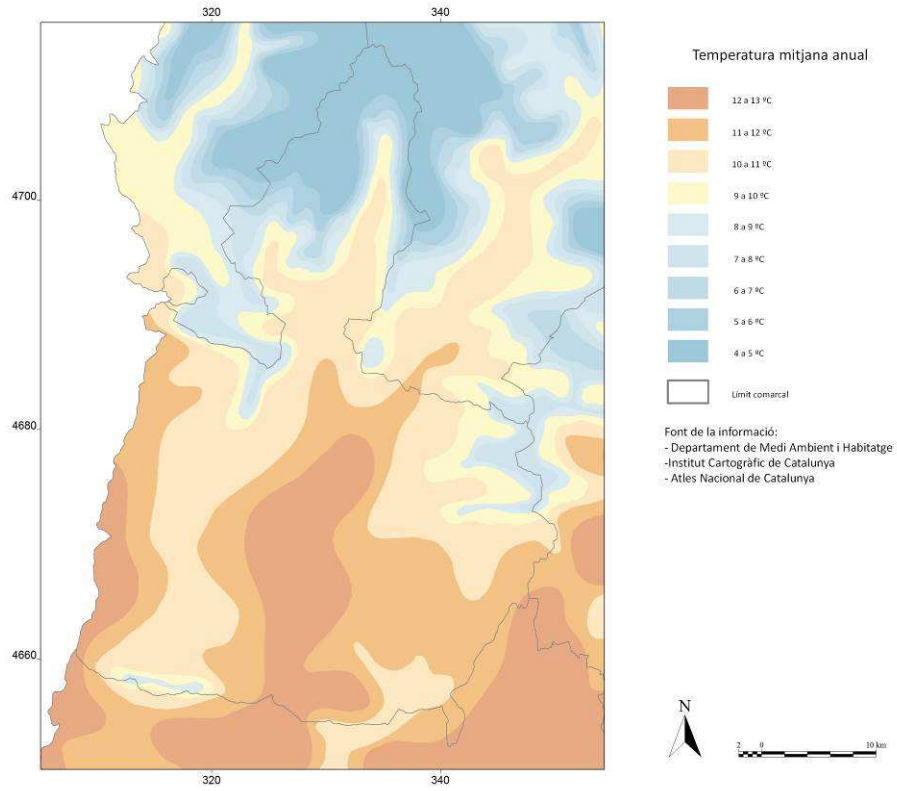


Fig.3 Average annual temperature at the Pallars Jussà region.

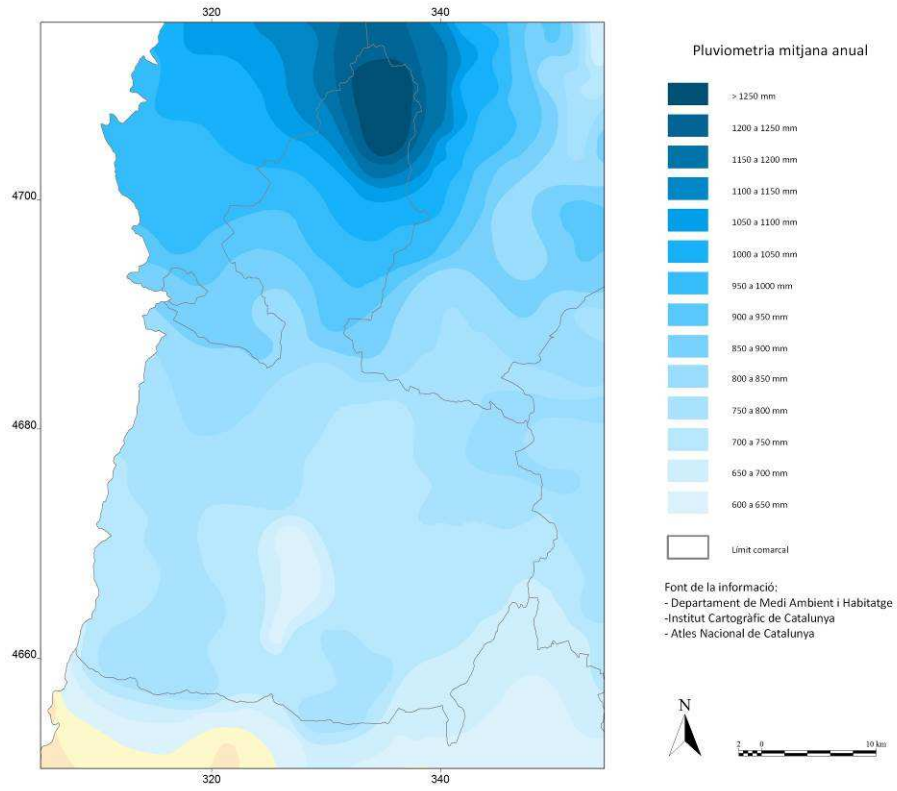


Fig.4 Annual pluviometry at the Pallars Jussà region.

Below are the Pallars Jussà and Alta Ribagorça regions average temperature/rainfall ratio diagrams and the specifications of the different weather stations in them.

Municipality	Period of registry (years)	Altitude (m)	UTM X	UTM Y	Average annual Rainfall	Average annual T
Sant Salvador de Toló (Bon Repós)	1943-2003 (32)	1,050	338,664	4,655,954	756.6	10.6
Terradets Dam	1940-1995 (43)	399	325,794	4,657,132	753.1	12.8
Reculada Hydroelectric plant, Gavet de la Conca	1940-1993 (54)	380	326,311	4,663,588	610.2	12.6
La Pobla de Segur	1997-2013 (14)	513	332,135	4,678,566	579.7	12.8
Montsec. Sant Esteve de la Sarga	2007-2013 (7)	1,572	312,204	4,658,169	723.7	8.4
Boí	2002-2013 (9)	2,535	326,136	4,703,893	1,072.1	3.7

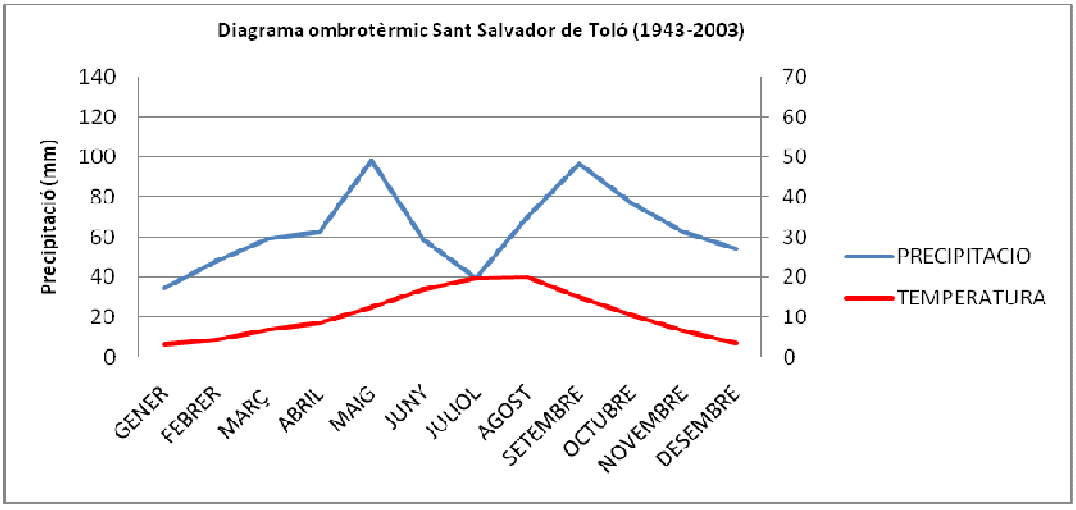


Fig.5 Average temperature/rainfall ratio diagram. Bon Repós weather station.

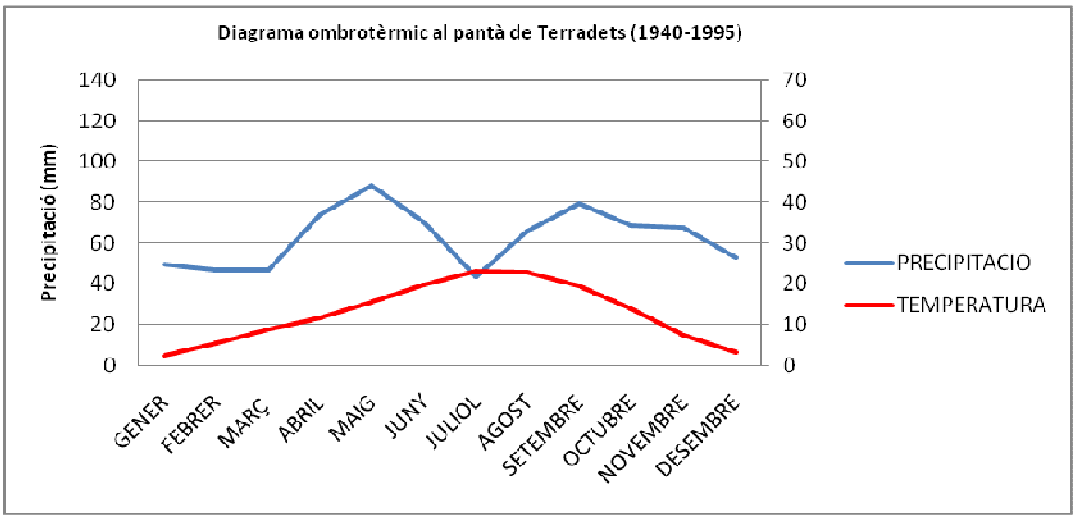


Fig.6 Average temperature/rainfall ratio diagram. Terradets weather station.

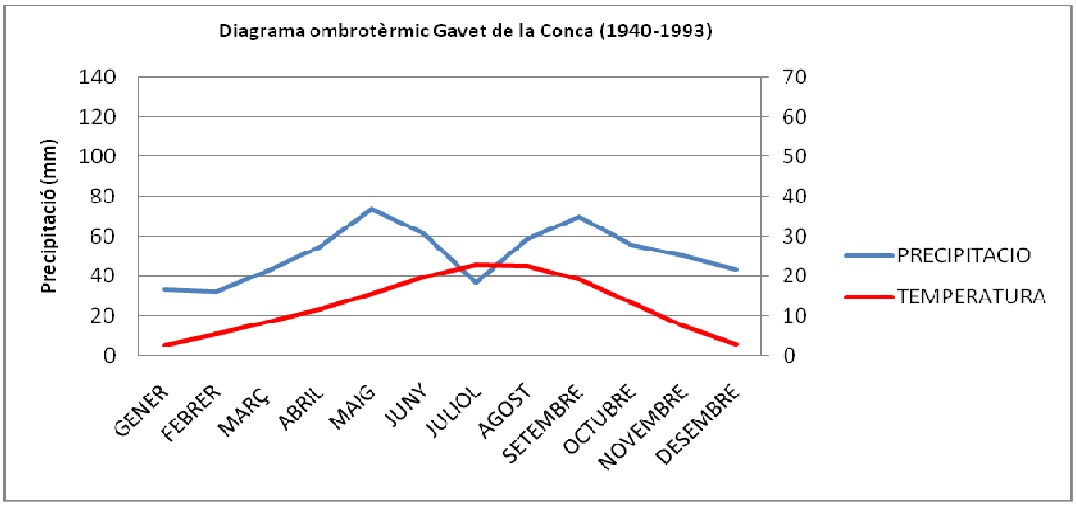


Fig.7 Average temperature/rainfall ratio diagram. Reculada Hydroelectric plant, Gavet de la Conca weather station.

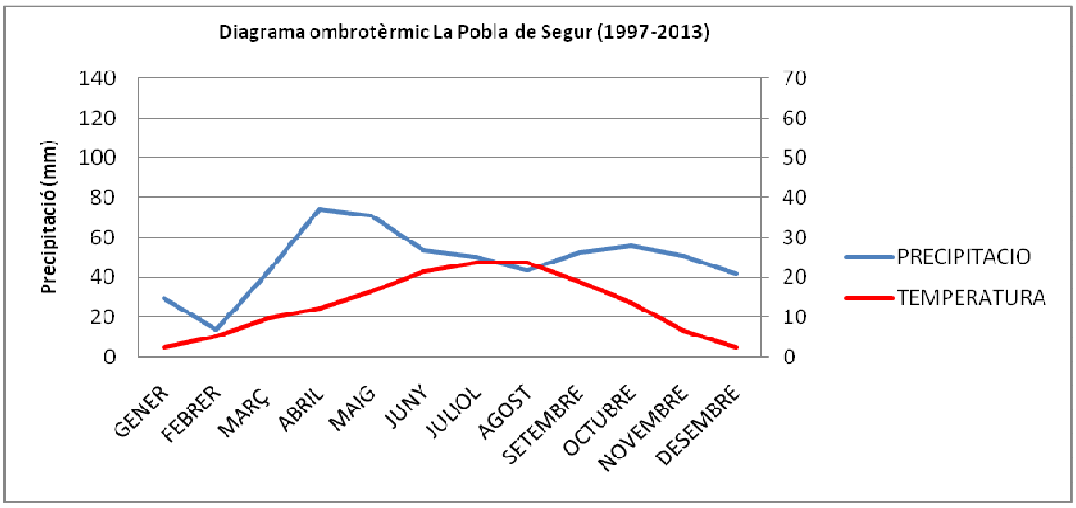


Fig.8 Average temperature/rainfall ratio diagram. La Pobla de Segur weather station.

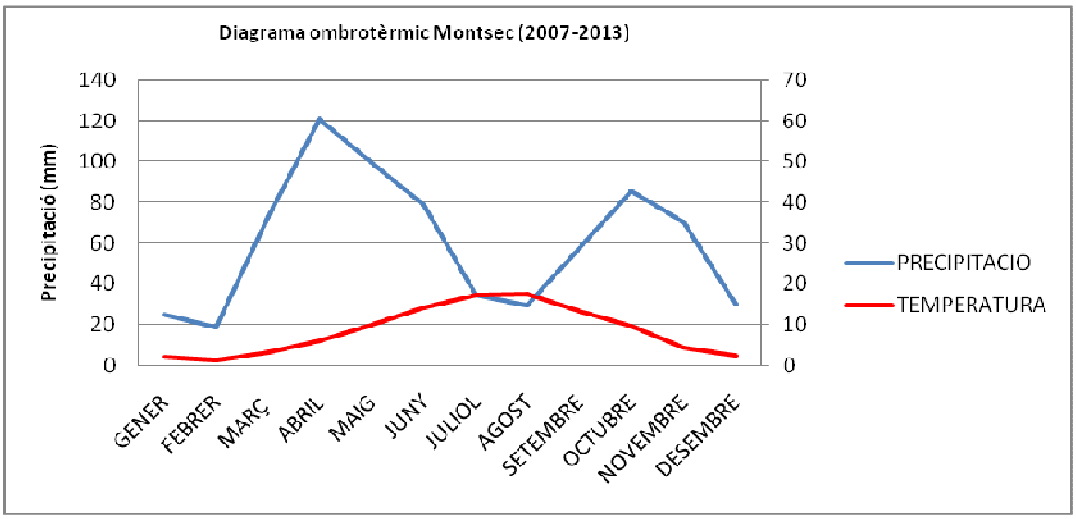


Fig.9 Average temperature/rainfall ratio diagram. Montsec, Sant Esteve de la Sarga weather station.

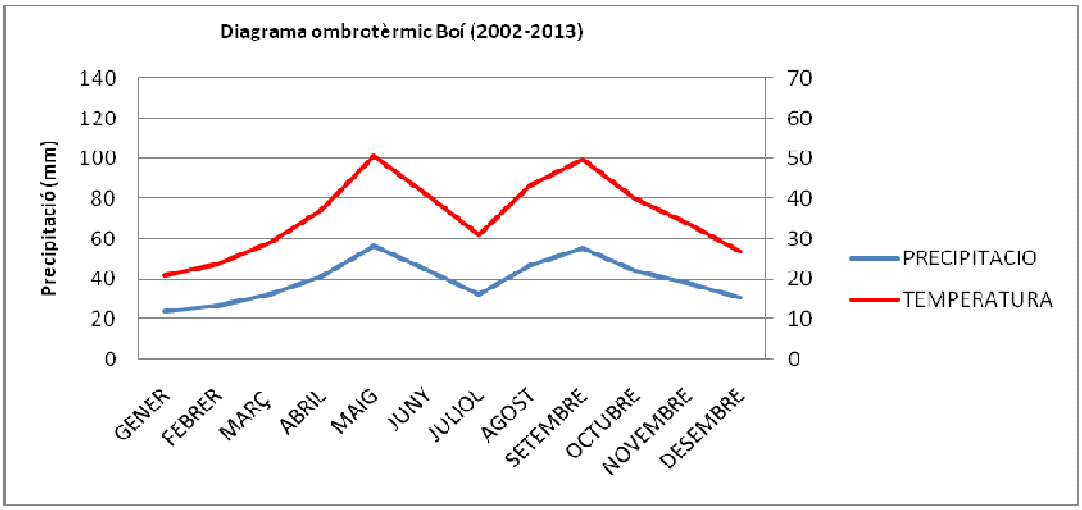


Fig.10 Average temperature/rainfall ratio diagram. Boí weather station.

3.3. **Physiography**

From a physiographical point of view, the Pallars Jussà region can be divided into 11 zones:

- Fosca and Manyanet Valleys
- Gurp and Montsor conglomerate mountain ranges
- La Terreta
- Castissent
- Dalt Basin
- Tremp Basin
- Dellà Basin
- Sant Corneli, Carreu mountain range, Isona and Boumort anticline
- Montsec mountain range
- Campaneta and Obacs d'Aransís mountain ranges, Llimiana and associated slopes
- Drainage system

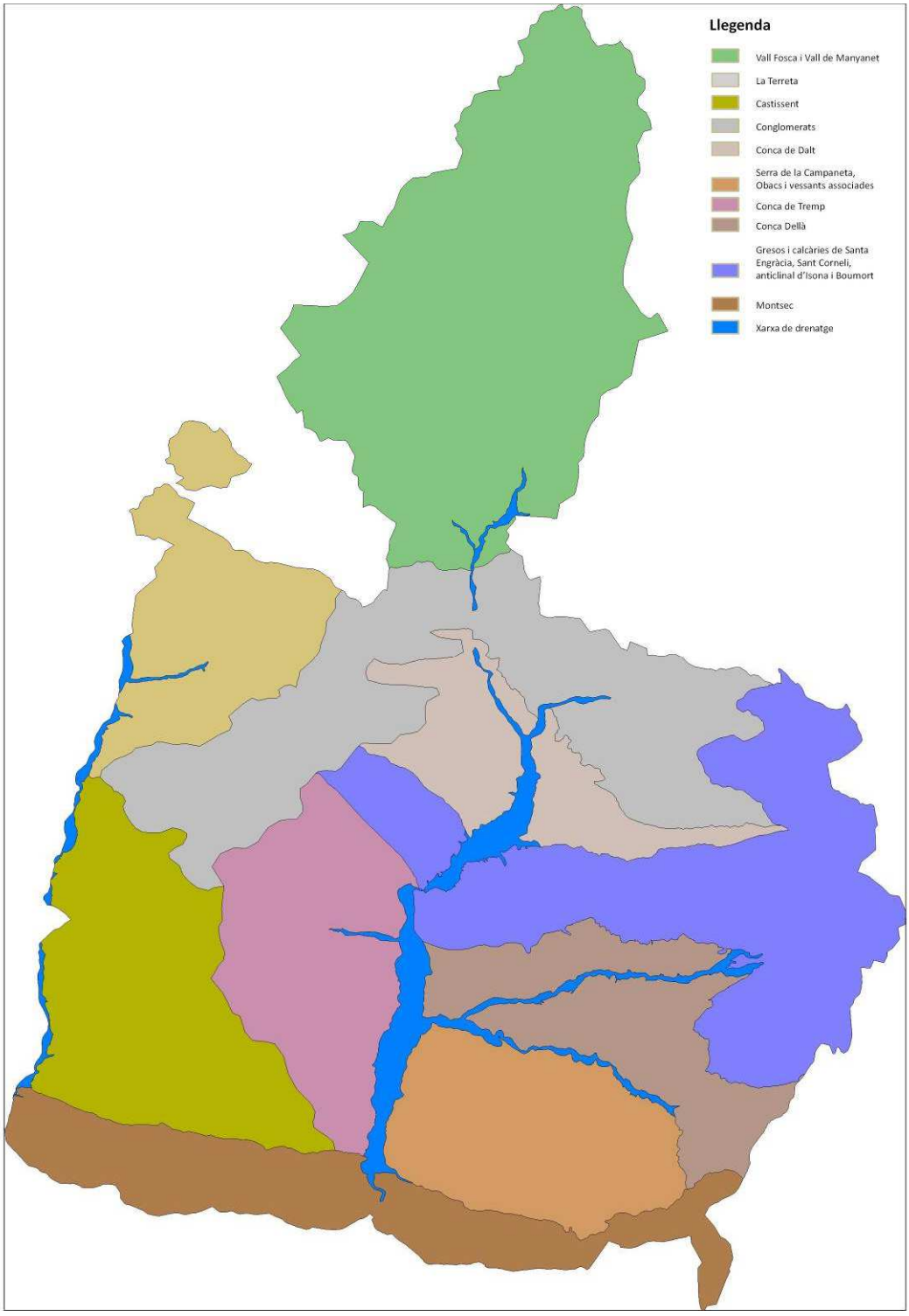


Fig.11 Physiographical units at the Pallars Jussà Region.

1 Fosca and Manyanet Valleys

Two parallel valleys in the north of the region drained by the Flamisell (Fosca) and Manyanet (Manyanet) rivers. It differs from the rest of the region not only by the materials that can be found here, but also by the climate -more humid and mild- which, in turn, favours a different type of vegetation. Forests in these areas are thicker and more humid, although it must be noted that most of them are basically the outcome of reforestation programs -and not always done with species typical of the area. On the other hand, the higher areas in both valleys are covered by pastures, usually devoted to bovine livestock growth.

The steep slopes of the valleys compromise the stability of the materials. Their geology is complex, specially due to the great diversity of materials found in them and their origin. The action of old glaciers has also shaped the landscape. This large area must be divided into different subzones, depending on the materials we find in them. Broadly speaking: granites, limestones, sandstones alternating with shales, red sandstones and conglomerates.

Fig.12 Fosca Valley highest area landscape, with granite materials, ponds and pastures.

Fig.13 Fosca Valley highest area landscape, with schistose materials and pastures above hooked pine tree reforestations.

Fig.14 Manyanet Valley landscape, with red sandstone materials.

2 Gurp and Montsor conglomerate mountain ranges

This is a big area shaped by conglomerates that outcrop easily to the surface. Thus, the soils of these areas are characterised by their thinness, except those that have developed in crevices, where more material has been able to accumulate. The slopes are quite variable, as the relief is formed in a way that it generates a series of terraces.

Broadly speaking, vegetation is scarce, although some slopes in the shadier parts were reforested with red pines and pines. Those reforested zones show a good development rate.

Most of the reforestations in the region were the result of complementary actions made to the construction of the several dams that can be found in the area. The aim of these reforestations is to slow down the erosion processes in the slopes, thus causing less sediments to reach the dams, which, in turn, greatly extends the life cycle of those dams.

Fig.15 Gurp conglomerate mountain range landscape.

Fig.16 Conglomerate landscape near Esplugafreda.

3 La Terreta

With evident erosion issues, we can find frequent badland zones in this area. As in many other zones in Catalonia, the decline in rural population has made human presence quite scarce in this area. Currently, la Terreta is an area of high value for environmental, landscape and wildlife aspects. We can find the Aulàs oak forest as well as several birdwatching spots, specially carrion birds as the common vulture, the Egyptian vulture and the bearded vulture.

The reliefs of the Sant Gervàs and la Terreta mountain ranges clearly stand out.

From a geological point of view, moving from the north to the south, we find limestones, sandstones and turbiditic shales, as well as interspersed alluvial deposits, which make up most of the agricultural areas.

Fig.17 La Terreta landscape, near Aulàs.

Fig.18 Sant Gervàs mountain range landscape.

4 Castissent

This quite large area is notable for its low human population density. Most of the towns and villages in this area slowly became depopulated as sheep farming, one of the traditional usages, went into decline in this area. In the areas where lutites outcrop, we can observe frequent badland formations and erosion processes caused by mass migrations. The vegetation of this area is mostly formed by scrublands, with disperse and isolate forested areas -basically made of oak trees or, in reforested areas, pine trees and maritime pine trees.

From a geological point of view, we find sandstones, conglomerates and red and grey shales.

Fig.19 Landscape near Castissent.

5 Dalt Basin

This is the area around the municipality of La Pobla de Segur. We mostly find cereal crops, olive and almond cultivation and some vestigial remains of old vineyards -although those are mostly non-existent nowadays.

From a geological point of view, the basin is formed by areas of alluvial fans, as well as turbiditic sandstones and turbiditic lutites.

Fig.20 Alluvial deposit at Sant Martí de Canals, with almond tree cultivation.

6 Tremp Basin

This area forms a basin where fog concentrates during winters due to the thermal inversion phenomenon. This phenomenon makes temperatures milder at higher altitude areas than in the lower areas of the basin.

The outer slopes of the Tremp Basin, coming from Coll de Montllobar, are formed by marls and lutites, starting with steeper slopes that turn into softer slopes to form homoclinal ridge formations. Finally, we find the largest agricultural extension in the region, most of it irrigated cultivations, which is formed by red lutites and several alluvial deposits. We also can find reliefs created by ancient alluvial fans in the higher parts of the area (e.g. Vinyes de Sant Miquel area).

FIG.21 Tremp Basin's Southern Side landscape as seen from the Coll de Montllobar.

Fig.22 Alluvial deposit at Vinyes de Sant Miquel in the foreground, with sights to agricultural cultivations at the slopes of Aransís and Llimiana and the Montsec in the background.

Fig.23 Agricultural landscape of the Tremp Basin, with the Montsec on the background.

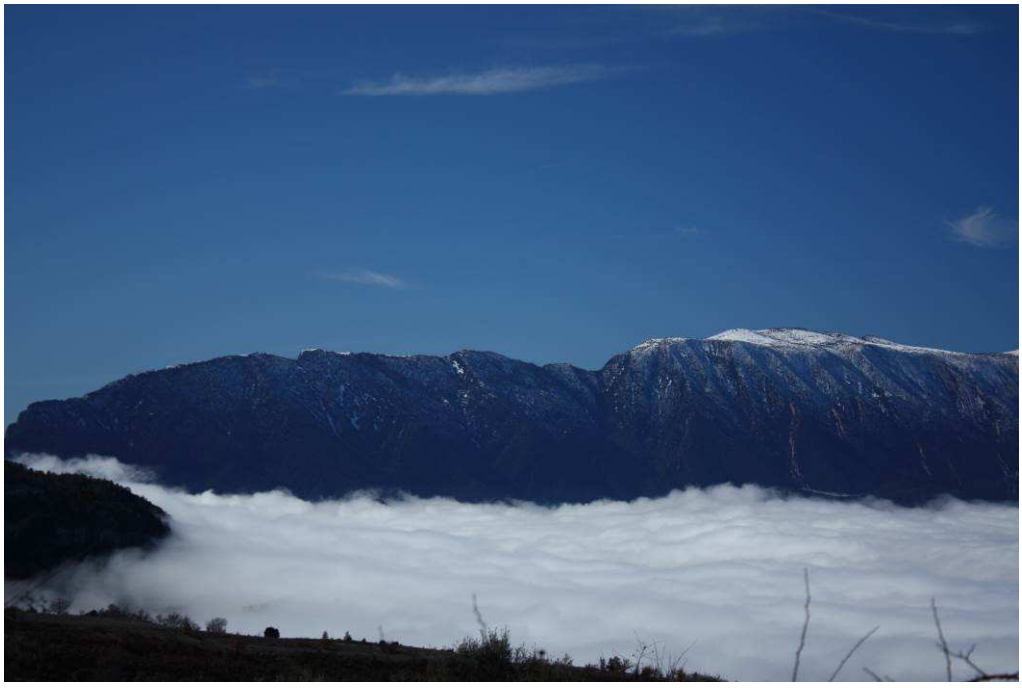


Fig.24 A view of the fog flooded Tremp Basin, taken from Aransís, looking at the Montsec.

7 Dellà Basin

From a geological point of view, the salient point is the appearance of travertines at the area near Conques and Basturs. We do also find an area of conglomerates near

Comiols. The alluvial cone that extends from Isona to Abella de la Conca is an area with a gentle slope mainly used for the cultivation of almond trees, although that usage is also being slowly abandoned in recent years.

Fig.25 Agricultural landscape at the Dellà Basin, with almond tree cultivations above the alluvial cone near Isona.

Fig.26 Agricultural landscape underneath the Benavent conglomerates. In the background, the Carreu mountain range.

8 Sant Corneli, Carreu mountain range, Isona and Boumort anticlinal

The Carreu mountain range and Boumort are two mountainous areas included in the Boumort National game reserve. This is an area with great fauna interest, where species as emblematic as the grouse and the bearded eagle can be found. From a geological point of view, we find limestones and conglomerates, which create the Collegats gorge, located at the neighbouring region of Pallars Sobirà.

Although this is mainly a forested area, the majority of the surface was affected in the decade of 1980s by a massive forest fire. The effects of this fire are still evident, especially on the sunny slopes, where vegetation still hasn't been able to fully recover.

At Sant Corneli, we can find calcarenites, calcareous marls and marls. At the Isona anticline, sandstone, calcarenites, marl and turbiditic sandstone.

The vegetation of the area is mostly forestry. If we move from the valleys to the peak of the mountains, we find, pines, red pines and hooked pines, depending on the altitude. At the highest altitude zones in Boumort, we can also find pastures.

Fig.27 Boumort mountain range landscape.

9 Montsec mountain range

The geologic material that shapes this mountain range is basically limestone. The walls we are able to see from the neighbouring region of Noguera also are limestones. This is the frontal layer of the Montsec Thrust. At the northern slope, as a more eroded second layer that goes until half that slope, we find the Areny sandstones.

The incline in this northern slope is far more steep. The vegetation of the area is formed by pine tree forests, maritime pine and red pine forests -those last two from reforestations-, oak forests and kermes oak forests. At the highest altitude areas, arboreal vegetation is almost non-existent and we find scrublands and pastures with bearberry, snowy melispus and box.

Fig.28 Limestones and sandstones at the Montsec mountain range, taken from Hostal-Roig.

10 Campaneta and Obacs de Llimiana mountain ranges and associated slopes

This area is shaped by a rather more mountainous terrain, at its centre, formed mostly by limestone with Alveolina, although we can also find sandstones and conglomerates. The surrounding slopes are made of red lutites interleaved with sandstone and some colluvial deposits.

Fig.29 Landscape at the slopes of the valley of the Barcedana river, with outcrops of red lutites, underneath the calcareous terrain.

11 Drainage system

Basically formed by the two Noguera rivers, the Noguera Pallaresa and the Noguera Ribagorçana, which run from north to south in the region. The former, starting its course in the Pallars Jussà at the Collegats gorge and exiting it at Terradets gorge. The later running its course as natural border with Aragon.

Tributaries worth mentioning for Noguera Pallaresa would be the Flamissell, Gavet and the Barcedana ravine. As for Noguera Ribagorçana tributaries, we find a series of ravines, the most salient of them being the Solà ravine.

Fig.30 Noguera Ribagorçana river landscape, near the Montrebei gorge.

Fig.31 Noguera Pallaresa river landscape, near the Tremp Hydroelectric plant.

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Fig.32 A view of the Noguera Pallaresa river near the Terradets Dam.

3.4. Geology

From a geological point of view, the Pallars Jussà region can be categorised as an area of high interest. In the Catalonia geological heritage catalogue, we can find as many as 10 geological interesting spaces linked to this region, from a geological and geomorphological point of view. Furthermore, we can find uncountable geologists from all around the world, be they students or professionals, doing field work in this region.

The Pallars Jussà region is geographically located between the Pre-Pyrenean ridges of the Montsec mountain range and the High Pyrenean ridges.

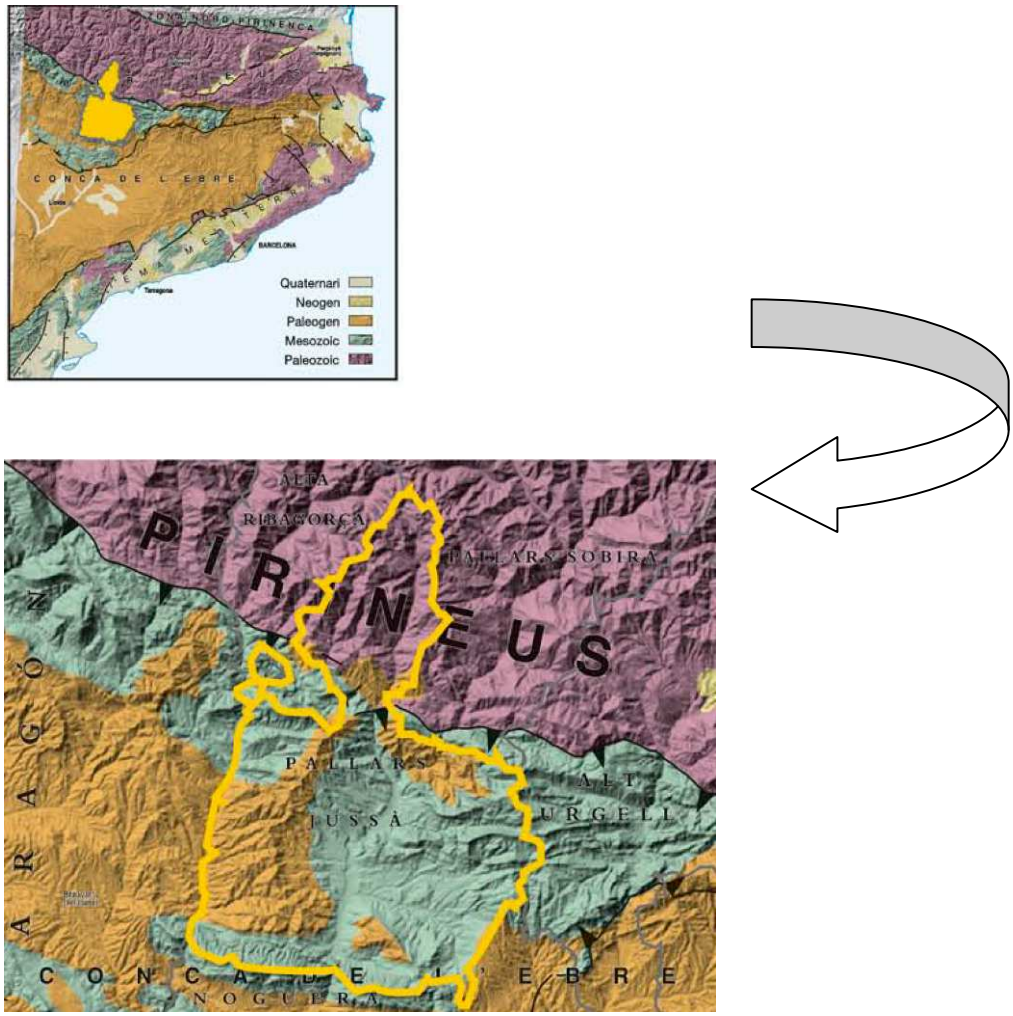


Fig.33 Geological eras at the Pallars Jussà region.

3.4.1. Lithology

The main materials that can be found in the region are:

PALEOZOIC

- Granites and granodiorites of Carboniferous-Permian age: Northern edges of the region, mostly found at Aigüestortes-Sant Maurici Natural Park.
- Sandstones and lutites in centimetric alternations of Cambrian-Ordovician age: from Cabdella to Pont de Rus.
- Lower Devonian slates and limestones: At Pobellà and Manyanet valley.
- Permian lutites and red sandstones: A strip crossing Fosca Valley from east to west near Castell-Estaò. This is mixed with Triassic materials: conglomerates, sandstones and lutites of Buntsandstein facies.

MESOZOIC

- Upper Cretaceous Sandstones and lutites: At la Terreta, Salàs de Pallars and Toralla.
- Paleocene (Garumnian) Conglomerates, clays and red sandstones: Tremp basin and Dellà basin.
- Upper Cretaceous Limestones and sandstones (Areny): at Montsec, outcrops at the northern side of this range. Also can be found and Isona anticline and in a vein that goes from Abella de la Conca to the Nerets and after the Sant Antoni de Talarn Dam to Santa Engràcia.
- Illerdian marls and lutites: from Tendrui to Guàrdia de Noguera, near the Tremp basin.
- Upper Cretaceous calcarenites and calcareous marls: at Sant Corneli.
- Upper Cretaceous Prealveolina limestones: Sant Gervàs mountain range.

PALEOGENE

- Eocene to Oligocene massive conglomerates and sandstones: at Coll de Comiols, running north to south, Gurp mountain range, reaching to Serradell and Erinyà and to the Monstor area -outcropping at diverse points from Montsor to Boumort.
- Eocene lutites, sandstones and conglomerates: from Montllobar to Pont de Montanyana, following the dividing line between the two Noguera rivers. As we approach the southern part of the Gurp mountain range, we can find a higher presence of conglomerates.
- Paleocene-Eocene Alveolina Limestones: At Llimiana and Campaneta mountain range.

NEOGENE AND QUATERNARY

- Pleistocene Travertines: at Mont de Conques.
- Quaternary alluvial fans with lutites, gravels and sands at several points in the region, as in Vinyes de Sant Miquel, from Rivert to Salàs de Pallars, Isona and Sant Martí de Canals.

If we stick to the area we are going to visit during the Transcatalonia, we can notice that the Tremp basin corresponds to the folding in synclinal form at the Montsec Thrust Sheet. The Montsec Thrust Sheet overthrusts the Àger basin -which geographically belongs to the Catalan Fringe mountain ranges- in the south, and in turn is overthrust by the Bòixols Thrust Sheet in the northern areas. All those thrust sheets have been tectonically displaced to the south in a piggyback sequence during the Alpine orogeny.

The following description has been extracted from the field work done during the elaboration of the soil map of the Isona area at the scale of 1:25.000, in which most of our visit takes place today.

3.4.2. Tectonic structure

The Tremp basin is upheld between the Montsec Thrust and the Bòixols Thrust, more precisely above the back of the former, on the Montsec Thrust Sheet. Thus, it basically forms a gentle syncline in between these two structures. However, at the western part of the basin, the syncline is somewhat a bit more complex, as it presents a composed syclinorium structure formed by three folding alignments running west to east: north, the Tremp-Abella syncline, related to the Bòixols Thrust -and which we can find turned upside down near Abella de la Conca; centre, the Isona anticline, of which the Mitjana mountain range is its coherent core; to the south, the Campanetes syncline, which connects with the ridge of the Montsec mountain range. The continuity of the limestone formations at the Mitjana mountain range is broken by strike-slip fractures with normal component, mainly running north to south, as those found east of Llordà.

The Isona anticline -the sole positive structure in the basin- was caused by the accumulation in depth of lutitic and evaporite materials (Keuper facies) above the South-Pyrenean Sole Thrust, as is proven by the data from the Isona exploration well and by the industrial seismic profiles in the area.

The activity of the Montsec Thrust must be dated around the sedimentation of the Garummian facies (Late Cretaceous and Early Paleocene), but its posterior 10 km. displacement to the south happened during Illerdian and lower Cuisian times. The Eocene-Oligocene conglomerates overlie the Thrust structure, and thus, define the completion of the placement process, but not that of further reactivations, as the ones which happen in the Oliana area. Figure 34 shows a geological cross section of the Dellà basin, with north to south orientation. We can find that the disposition and synclinal structure of the sediments in the Montsec Thrust at the Bòixols Thrust overlap above the north flank of the syncline.

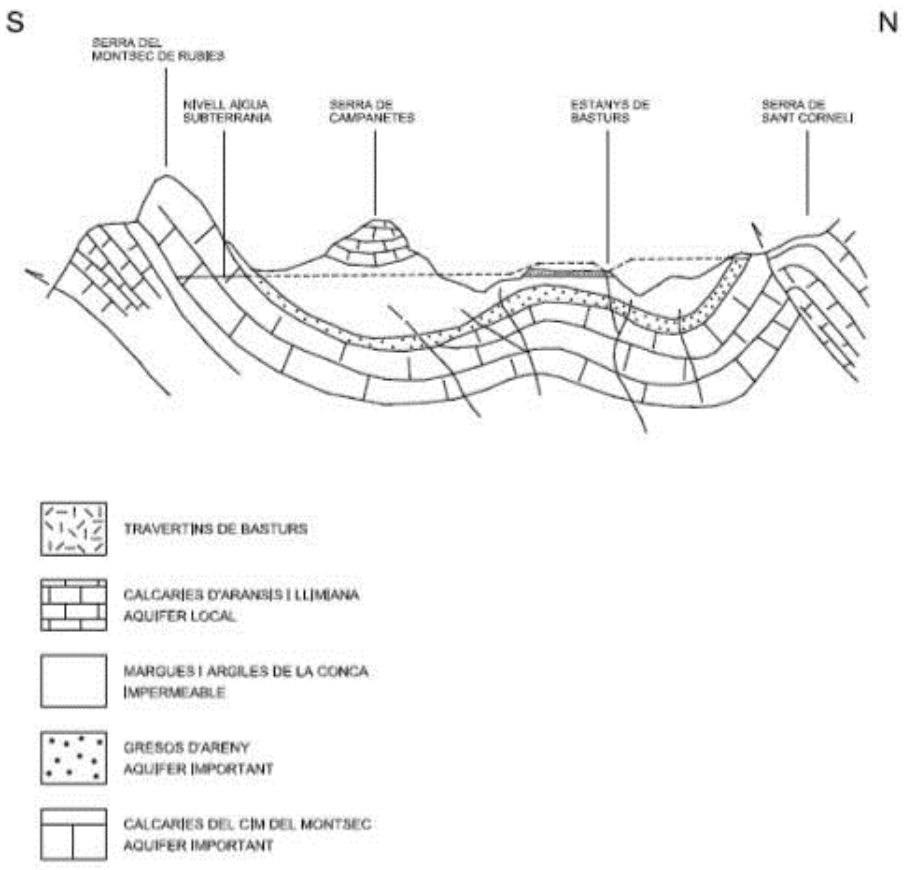


Fig.34 Geological cross section (N-S) of the Tremp basin, showing the structure of the Tremp syncline and the Isona or the Mitjana mountain range anticline. Taken from Pascual (1994).

3.4.2.1. Mesozoic and Cenozoic Stratigraphy

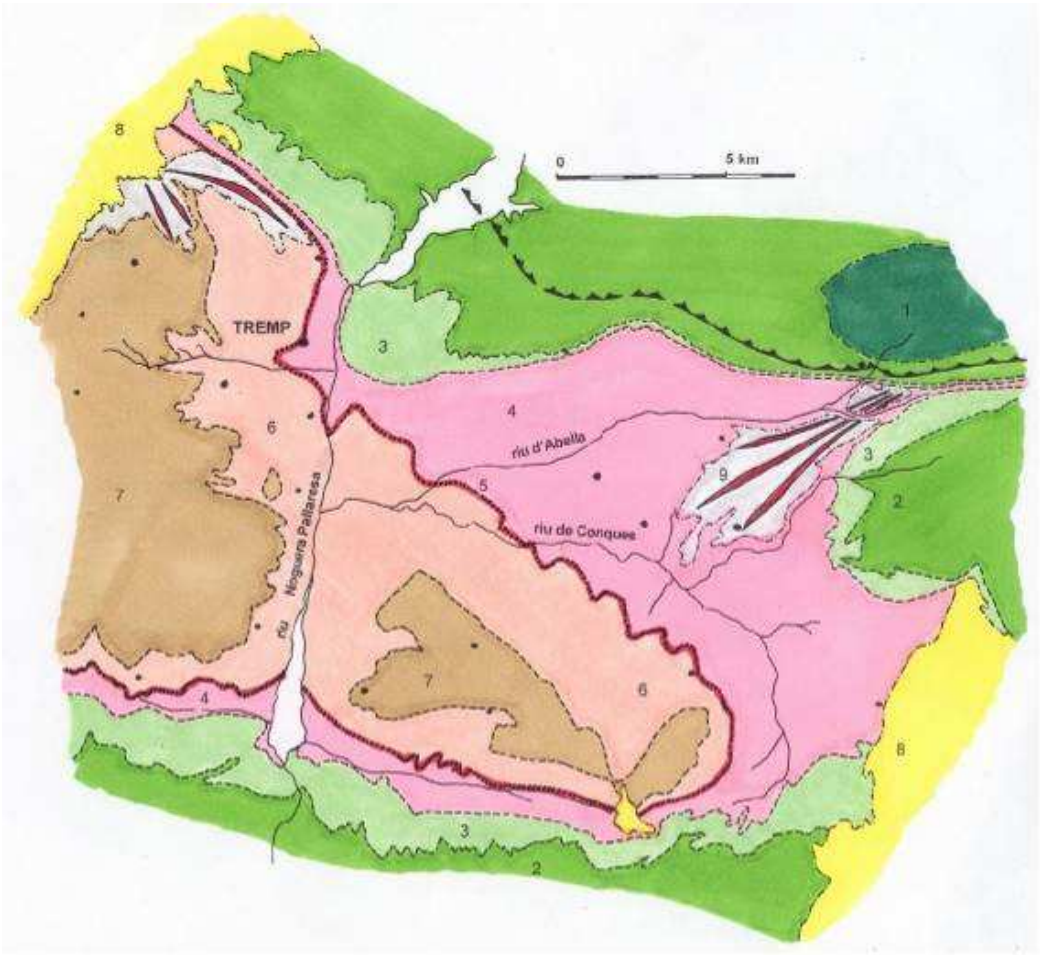
The Montsec Thrust Sheet is formed by a Mesozoic series of about 3,000 m in thickness, mostly made of carbonate sediments of Jurassic, Lower Cretaceous and, most saliently, Upper Cretaceous ages. We can also find Paleocene carbonates and detritics. This later sedimentary set shaped the Graus-Tremp Cenozoic depositional basin, from east to west.

Even though the lowermost materials can't be found at the reference zone, the sedimentary succession for the Montsec Thrust Sheet would be Upper Triassic (Keuper facies) at the base, then Jurassic, Lower Cretaceous, Upper Cretaceous, Paleocene and Eocene. To complete the picture, all the displaced series has finally overlain by Oligocene conglomerates. Figure 35 shows a synthetic geological map of the Isona basin.

The Jurassic section is formed basically by Dogger and Malm black dolomites. The Upper Cretaceous section is found at the core of the Bòixols anticline and at the basis of the slopes of the Montsec and is composed by limestones with Trocholina at the toe, calcareous marls, limestones with Characidae and micritic limestones (Rubies quarry). At the highest altitude part, we find coralline, reef-shaped Urgo-Aptian limestones, including rudists, miliolides, eichinoids, bivalves, briozoans, etc... This set can get to a maximum thickness of approximately 1,500 m.

The Upper Cretaceous section starts with the limestones from the Santa Fe formation and afterwards we find a central section consisting of marls of Santonian age. Afterwards, we find the green-greyish calcarenites from the Perles formation (Campanian-Maastrichtian).

On top, the Areny group sandstones, composed with yellow-white and ochre quartzarenites as ceiling, bioclastic calcarenites at the central section and blue-grey sandstones at the basis, which sedimented during the late Cretaceous (Upper Maastrichtian). Their internal structures consist of crossbedding of diverse scales.



Legend
1) Lower Cretaceous: marl and limestones
2) Higher Cretaceous: limestones at the south and marl at the north
3) Higher Cretaceous: Areny sandstones
4) Higher Cretaceous: marls with dinosaur remnants
5) Cretaceous/Paleocene threshold (65 My)
6) Paleocene: marls and gypsums
7) Illerdian (lower Eocene): marls, sandstones and limestones
8) Oligocene: conglomerates and sandstones.
9) Quaternary: Dejection cones made of boulders and cobblestones and silt matrix
▲▲ Overlapped edge of the Bòixols - Sant Corneli plate above the Montsec.

Fig.35 -Geological scheme of the Tremp basin with the representation of the main lythological sets. An extensive outcrop formed by marls with dinosaur remnants or garumnian marls can be observed (taken from Rivas et al., 2006). In many places, these outcropped materials are in a subsuperficial position, below a foreign quaternary coverture, which is what actually acted as original material for the soils.

The stratigraphic series is regressive: It ranges from shallow marine platform materials at the bottom to typical river sediments at the top. At the end of the sedimentation of this section of sandstones, we can observe, transitionally, sediments which were deposited in wetlands and marsh environments, including layers of lignite interbedded with the dominant materials. Those materials announce

the final retreat of the sea towards the west and the establishment in this area of a continental sedimentation with small meander like river courses. The average thickness of the Areny set is of some 500 m.

An in-depth study of the mechanisms of a marine regression can be made in this area, as we can find in a single cross section platform sediments (maritime), transitional sediments, delltaic, and finally continental and fluvial. The sediments of the deltaic facies, which clearly outcrop at the road cross section, clearly indicate this was, in its origin, a delta dominated by tidal forces (a typical estuary) in which the stratification forms are clearly subtidal and intratidal (basis of the Areny sandstones). Near the ceiling, we can find layers caused by continental storms (fluvial flashes). At the ceiling, we can find the grey clays (grey Garumnian) which shape the majority of the Posa gorge (NW from here). Those facies are of great interest inasmuch they have been deposited in a very proximal intratidal area (mixed & mud flat) and in a supratidal ambient with swamp and marsh areas amongst what is a muddy area (swamp & marsh)(Nagtegaal et al., 1983. Ardévol et al., 2000) Those later greyish layers present a highly varied palaeontological content: From clearly maritime fossils (Hippurites castroi and corals) to brackish (gastropoda and the bivalve Corbicula laletana) and even some continental ones, amongst which we can find the eggs, icnites and skeletal remnants of dinosaurs -some of the latest surviving ones worldwide and certainly the last to inhabit the Pyrenean area(Rivas et al., 2006).

The Garumnian facies, known as Tremp set in modern times and formed by a diverse set of formations (Posa, Conques, Talarn, Suterranya, Sant Salvador, Esplugafreda and Claret), is composed by sediments ranging from the Higher Cretaceous to Lower Illerdian.

It is composed by a basis with brackisk deposits, with the alternation of continental and lacustrine levels -lythologically represented by marl and clay layers with some limestone and lignite levels. This part of the series would correspond to the Higher Cretaceous (Higher Maastrichtian). Above that we can find a level of lacustrine massive limestones that signal the transition from Higher Cretaceous to Paleocene (considered as the sauropod extinction event mark, 65 million years ago). The higher section of the facies is composed, once more, by marls with some interseeded sandstone and conglomerates and some multicoloured lutites. It is safe to say that

the beginning of the Paleocene times. From a geomorphological point of view, the lacustrine limestones stand out as coherent levels in the Garumnian set and give origin to reliefs and mountain ranges, such as the ones which delimit the Dellà basin on the west (Castellnou mountain ranges, Sant Salvador de Toló, Carreró, Tossal, Puig, Pedrós, Saladelles, etc...). The garumnian materials set can gather a variable thickness, with a maximum of around 700 m.

Afterwards, we find again another regressive stage with the deposition of limestones which were deposited in shallow water platform environments. These are the Alveolina limestones (lower Eocene; Ilerdian) which form the cliffs of the Campanetes mountain ranges, Aransís and Llimiana.

Finally, the Comiols conglomerates, uppermost Eocene and early Oligocene in age, unconformably overlie the materials forming the Montsec Thrust Sheet. At the bottom, they consist of breccias formed by blocks and clasts of local origin, overlain by a thick section of polymictic conglomerates. They are organised in metric layers of conglomerates which show channel infilling geometries. They are orthoconglomerates, with well rounded pebbles with diameters that range from few mm. to 70 cm. and average some 8-10 cm. The matrix is formed by sands and red lutites and is cemented by carbonate. The thickness of the whole conglomeratic section reaches 150 m.

The conglomerates in the Comiols-Benavent ridge correspond to the syn-orogenic and post-orogenic sediment sets accumulated in the sector that currently goes from Montsec to Mig Rialb. Classically speaking, they represent the “Pyrenean molasse”, that is to say, the remnants of the early dismantlement of the reliefs rose in the internal zones of the Pyrenean mountain range, and mark the end of the sedimentary cycle linked to alpine orogeny. The stratigraphic succession which shapes the Montsec Thrust Sheet was originally overlain by the Oligocene conglomerates in the very same way that we find them in the edge areas of the basin (Comiols, Tolva, etc...)

Therefore, following the overture and settlement of the Noguera Pallaresa system and the cutting at Terradets gorge, tributary river and torrent base levels fit in deeply and dig the basin sediments, especially those lythologies less resistant to erosion: The Garumnian marls.

3.4.2.2. Quaternary material coverings

The geodynamics during the Quaternary times is partially governed by the remarkable low coherence substrates of the Garumnian facies in the Dellà basin. The Quaternary materials can be classified into four main types:

- detritic sediments that form the alluvial cones and superficial formations of the slope that covers the Isona depression; ancient dejection cones and regularised slopes at Orcau.
- travertine material sets generated around the springs of the Tremp synclinal aquifer.
- detritic accumulations at the Benavent slopes.
- terraced aligned fluvial sets around the Abella and Conca rivers.

a. Ancient dejection cones between Abella and Conques

If we position ourselves at Abella de la Conca, we can notice the huge dejection cone, triangular in shape, which extends itself from the Forat de Abella de la Conca towards the south-east, towards Isona and St. Romà d'Abella. Other cumulations related to this level can be found forming a piedmont at Sant Corneli, between Orcau and Abella de la Conca. Its topographic area forms a cumulation glacis from the Mid-Higher Pleistocene with an incline of 3º to 4º at Isona and much steeper at the apex area. The travertine set at Conques is the confluence sector of all those surfaces. This level finds itself raised 90-100 m over the present day Abella river thallweg.

According to Linares et al., (1999) the most ancient gravel and pebble deposit is actually formed by two levels divided by a white paleosoil with carbonated cement cumulation (petrocalcic horizon). These two episodes can be found superseeded in the field, being the superior one the most recent, although this set can be considered a single cartographic unit. Other authors (Peña; ICC, 2001) consider these are two completely independent levels divided by a clean lapse of erosion.

The higher conglomerate set (Qvi from ICC, 2001) is well developed at the Isona map, during a 5 km section. It is partially cemented with a moderate selection and an average thickness of 3-4 m, but can reach a maximum of 15 m. The clasts are well rounded and do not usually go over the 30 cm. in size. The matrix is composed by

sands and can reach a 40% percentage. The materials clearly stem from the Alt Abella area, as the clasts are of carbonated nature from the Lower Cretaceous (as the ones found at Bòixols anti-cline) and from calcarenites from the Areny formation (Linares et al., 1999). These are torrent and river deposits, of the linked type, dating from Mid-Higher Pleistocene (ICC, 2001).

The lower conglomeratic level (Qv3 from ICC, 2001), slightly or not cemented at all, is made by a 2-3 m thickness deposit in clear erosive contact over the Garumnian. The clasts are rarely larger than 20 cm in diameter, with average rounding and a moderate selection degree. Those clasts are of local origin (Areny quartzarenites and Garumnian). It is located in the northern and southern edges of the higher conglomeratic level and dated at Higher Pleistocene (ICC, 2001).

The disconnection between the materials of these cone shapes with the present drainage system is obvious by the obliquity that can be observed. At the Abella-Isona cone, the cementation processes (formation of petrocalcic horizons) are rare and reduced to small superficial layers of 2-3 cm., near Isona (Peña, 1983).

b. Orcau-Basturs regularised slopes (Sant Corneli-Bòixols mountain range slopes)

The southern Sant Corneli slopes (Costa del Llarg), deposited at the Orcau-Basturs area, show hung remnants of regularised outcrops at diverse heights over a superficial formation quite similar to the Abella-Isona cone. The tallest, dominant set (740 m) corresponds to the higher conglomeratic level (Qvl) deposited during the Mid-Higher Pleistocene. The areas shaped over these deposits at the Orcau sector present inclines ranging up to 15%, quite some difference in comparison to the Abella-Isona cone, which averages circa 4%.

Gravels can be found strongly crusted in at the superficial part, but well cemented levels can also be found in the interior sections of the calcareous cumulations (petrocalcic horizons). This crust would be indicative of a prolonged edaphogenetic process. The overall thickness of this cumulation, under 15m, can be observed in the cuts caused by the settling of the most important gullies.

Underneath the former, we can find a more recent second layer of regularised slopes (Qv2), quite broken by the cuts made by present day gullies, which have a closer

relation with the Abella river drainage system and which link to the T2 terrace of this river.

c. Travertine layers at Conques and Basturs Pond

At the heart of the Dellà Basin, amongst Conques, Figuerola d'Orcau and Basturs, we can find the Mont de Conques, a flat surface relief (700m), isolated between the ancient layers of the Orcau and Isona glacis. It corresponds to a travertine complex formed from the springs -highly rich in calcium bicarbonate- which outcrop in this area. Those travertine formations are of a whitish colour and present a sand like and dust like aspect or layered aspect. Travertine formations appear shaped as terraces that keep a close relation with the progressive layers of regularised slopes.

The most ancient deposits form the Mont de Conques (Qtve from ICC, 2001) and show a dome shaped formation with some circular depressions similar to plastered dolines, from which the travestine facies start growing on the edges. The thickness of the set is quite irregular due to the disposition of the travertines on the slopes and reaches a maximum of about 40m. They are related to the higher conglomeratic deposits from the ancient fans (Qvi) as they fossilize them. They are attributed to Mid and Higher Pleistocene.

The lower travertine layer (Qtv_3 from ICC, 2001), found between Figuerola d'Orcau and Basturs, is of more recent creation and is developed at a lower height. It exhibits slope travertine facies at the areas near the Abella river and its disposition is subhorizontal, with decimetric layers in the highest part around Figuerola d'Orcau and Basturs. The thickness of the set is also irregular and can reach 15 m. They can be found superseded at the lower conglomeratic material fans, as can bee seen in a cross section at Gros de Basturs Pond access path. This level is attributed to Higher Pleistocene. This cross section corresponds to the one that will be visited during Transcatalonia 2014.

d. Slopes beneath the Benavent conglomerate slopes.

The slopes in this piedmont have a 7º to 10º incline and have a 4 km. extension. The cumulation is composed by clay materials, which include pebbles coming from the dismantlement of the conglomerates. medium shaped blocks, and, finally, huge

monolithic blocks that remain scattered among the cultivation fields. South of Covet, those blocks can reach 25 m in length.

At the southern part of the Benavent piedmont, we can observe an important change in composition, as Maastrichtian sandstones replace garumnian clays at the base of the conglomerates. In the cross sections of road C-1412b, we can observe the inner structure of this new kind of cumulations, formed by ordered, stratified deposits or quite potent *grèzes litées*, which have been used in the conditioning works of this road. They are formed by angular clasts of sandstones which form alternating layers rich in silt matrix with others that have been highly washed. This alternation can be related to the precipitation in form of snow and the formation of ice over the slopes, which would deny the washing away of the richer levels, and episodes in which the snow melted waters would wash away the thinner sediments accumulated between those richer layers. Precipitation of carbonates can be observed in those different layers, as a consequence of those being the preferential layers in the hypodermic or subsuperficial retention wash in the cumulation. The maximum thickness can reach 40m.

In the Central Pyrenean area a great number of *grèzes litées* can be found, mainly developed at a starting height of 600-800 m. Estimations indicate that more than one phase of generation exist, although the main phase would belong to Late Glacial (Peña et al., 1988).

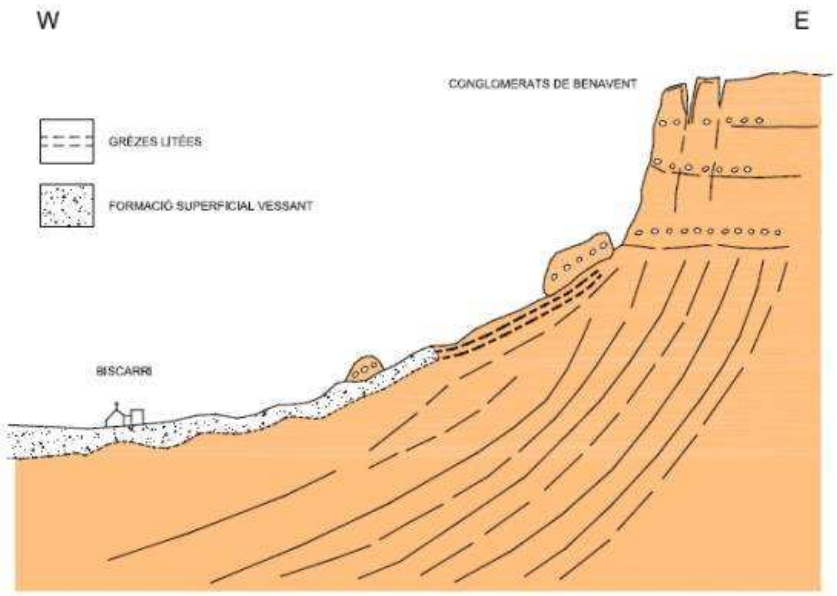


Fig.36 Outline of the slopes formed at the basis of the Benavent conglomerate slopes with grèze litées and further down a superficial formation with clear signs of solifluction (exaggerated vertical scale).

e. River terraces of the Abella and Conca rivers

Along the watercourses of the rivers, Abella at the northern side of the depression and Conques at the southern, a set of relatively developed river terraces is lined up. The base level of those river terraces remains below the base levels of the Orcau regularised slopes and the travertine sets. Thus, those terraces are formed during a later settlement episode than the other, more elevated in height, cumulations, which could be dated starting at Higher Pleistocene.

They are formed by gravel and non consolidated gross pebbles, which in the ceiling turn into deposits more sandy and clayish-silt with isolated pebbles in nature.

In both rivers, the set of terraces is formed by three levels at different heights:

- T_2, 20 to 22 m above the rivers with a 4-5 m thickness and dating from Higher Pleistocene.

- T_1, some 4m above the rivers, also dating from Higher Pleistocene-Lower Holocene and with a thickness of 3 - 4 m. It specially emerges in the western section of the Abella river.

- T_0, is topographically placed 1.5-2 m above the river thallweg and is considered as Holocene in origin.

3.4.4. Geomorphology

The Tremp basin is a depressed relief with west to east direction carved by erosion at the central Pre-Pyrenean zone, placed between the Sant Corneli-Bòixols mountain range alignment in the north and the Montsec alignment in the south.. The western limit of the basin is delimited by the Montllobar mountain range and to the west by the slopes of the Comiols mountain range. Inside the Tremp basin, we can find the reliefs of the Llimiana, Aransís and Campanetes mountain ranges. The total area extends itself for approximately 200 $km^{2.}$

The western part of the Tremp basin constitutes a physiographical subunit well delimited known as the Dellà basin. This space would be drained by the headers of the rivers Abella and Conques until their confluence, which matches the enclosure of the mountain ranges and reliefs at Les Saladelles - Puig Pedròs - Carreró. The town of Isona, located at the heart of this western depression, is the administrative capital.

The difference in height between the mountain alignments that surround the basin and its lower point is of some 600-700 m, without finding sudden breaks in the shapes of the reliefs. The contacts happen through regularised slopes of large extension as in the north and north-west or through large connection slopes at the rest of the set (Peña, 1983).

The shape above the Oligocene conglomerates at the East edge of the basin is constituted by a 6km long rectilinear continuous ledge, between the Port de Comiols and the Mitjana mountain range, where it starts thinning out and finally disappears. Scarp height -or conglomerate front- can go over 100 m at its central part, above Benavent. The primary orientation of the scarp is towards the north-west.

Due to an orthogonal diaclassment generalised network, which stressed the two folding directions of the sector, a Montserrat-like shapeliness is favoured and, although not overtly characteristic, it manages to create monoliths or large conglomerate needles that slowly detach from the ledges and can, in time, detach

from the scarp and end up collapsing. The process of collapse of these large blocks is favoured by the marl basis above which the conglomerates lay (Peña, 1983). The collapsed blocks are carried down the slopes by solifluidal processes and landslides, probably in previous climatic conditions that were somewhat colder and more humid, related to a Periglacial dominion. This collapse process has stabilised, in a conservative estimation, since the Middle ages, as the settlement of population at the feet of the slopes would suggest (Benavent, Perolet, Balasch or Covet).

The municipality and the Castle of Llordà are placed on a mound above the Areny sandstones where the Mitjana mountain range anticline is set. This structural relief, which follows to the point the shape of the folding at the Isona anticline in west-east direction, is a superb example of the classic morphology of the Jurassic relief know as original anticlinal ridge. This folding set is strongly dissected by some enclosed main valleys and directed towards the periclinal end of the fold and parallel to its axis (to the west, Llordà) and other secondary valleys that follow the trace of the layer lines or separation between materials of different resistance.

The quartzarenites with carbonated cement from the Areny set are clearly karstified with the appearance of dissolution shapes of the karren type at the walls of the discontinuities that cross them, as the diaclassis -where we can notice the clogging of these discontinuities with red thin materials, debris from the karstification (from the type terra rosa).

The travertine formations form the positive and highlighted reliefs, as at the Mont de Conques at 700m, despite the poor consistence and the high porosity of this kind of rocks. From a geomorphological point of view, the travertines act as a relative protection for the lutites forming their substrate and do not allow their gully erosion. The result of this behaviour is the generation of inverted reliefs where ancient valley end sectors now dominate the relief.

The slopes of the basin, shaped over the marls of the garumnian facies, show a marked undulation or bulge that is characteristic in the solifluction processes, where the unequal soil translation vectors break the continuity and the regularity of the topographic surface. There are quite noticeable drainage evacuation problems at the agricultural areas, where endorheic areas with stale waters can be found. This effect precisely impacts the acceleration of the process, as it produces a new water supply

to the soil and favours the infiltration, even causing the clays to acquire a plastic behaviour.

To sum up, the geomorphological evolution of the Tremp basin, and of the Dellà sub basin, in turn, are determined by the verified resistance of the materials that form it. Thus, a strong excavation of the poorly coherent materials -found at the bottom of the depression and formed mainly by Garumnian clays- has happened (from the point of view of their resistance to erosion processes). The reliefs that surround the depression are made of coherent materials and thus are erosion resistant. South of the basin, we can find the limestones and calcareous sandstones from the High Cretaceous, which form the subsequent underside at Montsec de Rúbies (Montsec Thrust). To the north of it, we find the Sant Corneli mountain range and Bòixols escarpments, also composed by limestones from the Higher Cretaceous.

Above the lutitic materials composing the depression bottoms, huge cumulation regularised slopes have been shaped (some authors, Peña, 1983, for example refer to those as glacis). Those superficies present themselves in three levelled terraced forms, perfectly individualised in Higher level (Qvi), Mid-Higher level (Qv3) and Lower level (Qv2), which in turn relates to the terrace Qt2. The regularised slopes are found at the feet of Sant Corneli, between Conques and Basturs. The Higher level (Mid-Higher Pleistocene) constitutes a set of plateaus from the primitive slope, the remnants of which have been preserved until present days (Peña, 1983). The travertines dome at Mont de Conques stands out at the heart of the bottom of the basin and its platform looks to be either aligned or a bit above the base level of the highest regularised slope (Qvi), which would link it to the paleoslopes and the most ancient travertine emissions (Fig.37).

To sum up, even though the garumnian marls played an important role in the creation of the depression, the materials responsible for the detailed morphology of the sides of the depression are the quaternary deposits with regularised slopes. Those deposits have cumulations of calcium carbonate (calcic subsurface horizons) and, sometimes, petrocalcic horizons. The grade of cohesion of the first and the cementation of the later grant those more ancient structures higher levels of resistance to erosion than the underlying marls. Later, the washing away effect of

torrent streams have respected the surfaces of those regularised slopes and left them as residual elevated surfaces with respect to the present day thallwegs.

Finally, we can conclude that the relief at the Tremp depression set is a structural relief with differential erosion towards the structure of the syncline. However, the reliefs linked to the erosion of the bottom of the valley, at the garumnian substrate, are reliefs with differential inverted erosion, as the highest elevation points in those surfaces correspond to ancient valley bottom structures (slopes and travertines from the Mid-Higher Pleistocene.)

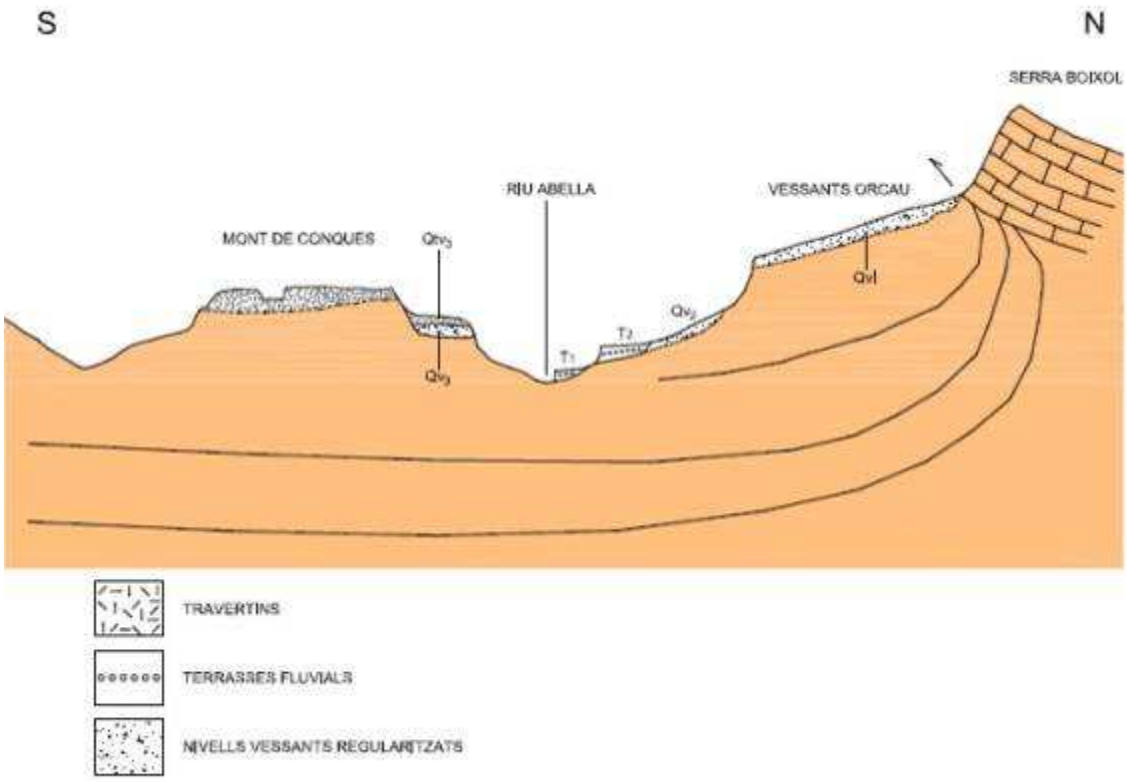


Fig.37 Outlined cross section (N-S) that shows the spatial relations between the Orcau-Basturs regularised slopes, the Mont de Conques travertines and the levels placed at a lower level.

3.4.3. Hydrographic system

The most important rivers at the Dellà basin are the Conques and Abella river. They drain their streams towards the Noguera Pallaresa region, at the west. The header of the Conques river drains the south-west sector of the basin, between the Campanetes mountain range and the western section of the Montsec, at the feet of the Comiols-Benavent mountain range and the Mitjana mountain range. Down the stream, this system drains the clays and marls from the depression bottom, leading

this water through the southern section of the Conques elevated platform. On the other hand, the Abella river drains the northern sector of the basin, it flows from the western side of the *combe* of the Bòixols anticlinal (Carreu and Carrànima mountain ranges) and it crosses it through the settled gorge with the same denomination. Once this water stream gets to the clay and marl materials of the bottom of the depression it heads towards the west running by the northern side of the Conques platform.

Most of the times, the morphology of the drainage system is very indicative of the different kinds of substrates and structures over which it flows. The Abella and Conques rivers have carved their river corridors in the spaces left among the less coherent materials that were to be found at the Isona dejection cone, the Orcau regularised slopes and the Conques travertine platform. That is to say, the remains of the Quaternary structures are quite more hard to carve than the clays of the Garumnian substrate and this dynamic led to a relief inversion.

The small tributaries at the Abella and Conques rivers which have settled over the Garumnian lutitic sediments form a dendritic system with a very high drainage density (areas of badlands), as would correspond to a drainage pattern set over highly impermeable and loosely coherent rocks.

The system draining the slopes at the ridge of the Montsec is of a consequent type, that is to say, it follows the northwards incline in the limestone flank. At the other edge of the basin, the slopes of Sant Corneli and Carrànima present watercourses that are obsequent with the settlement structure. The drainage at the Bòixols *combe*, perhaps tributary to another system in ancient times, now flows towards the south, running into the Abella river and making this river's contribution even bigger.

Over the folded limestones at the Mitjana mountain range anticlinal, the developed system adapts itself perfectly to the folded structure, forming a subsequent system, as if it were a dome, and a minor system that gathers the consequent contributions. The Francolí and Coromina vast gully stands out at this spot, rearly draining the whole structure by itself.

The torrent system settled over the Isona dejection cone presents a particular low density disposition, characterised by a series of large sub parallel valleys (Vall de

Mas de Mitjà) that wash the surface of the cone following the biggest incline route at West-SouthWest.

The surface of the Benavent conglomerates is drained by a series of torrents that follow a pattern of coherent type with a southward incline and, thus, the waters do not head towards the Noguera Pallaresa as in the rest of the system but towards the Segre.

3.4.4. Hydrogeology

From a hydrogeological point of view, the synclinal structure at the Tremp-Isona basin contains an important captive karstic aquifer at the Arenys sandstone set and at the limestones from the Higher Cretaceous levels that discharges in an artesian way into the Basturs ponds, among other points. Thus, the limnimetric level of the Basturs ponds shows all the variations that affect the hydrodynamics of the aquifer at the Tremp-Isona syncline (Pascual, 1994). The working system of the Basturs ponds is formed by the Gros (big) pond, the Xic (small) pond and the puddled area at Les Bulles. That later area only visible during high humidity episodes.

Whilst the present day Basturs ponds are situated at 638 m, over the lower travertine deposit of the Conques system, another set of non-functional depressions filled by fine sediments with a high amount of organic matter are placed south from the former, around 660 to 700 m over the higher travertine level forming the Mont de Conques (Cassola, Col·lector, Fornons, etc... ponds). Between those two sets, we can find the Marcel·lí pond, at an intermediate level (626 m) with a quite shallow depth layer of water which is being drained to supply the municipality of Figuerola d'Orcau.

The underground water ascends to the surface through the fractures that pierce the garumnian materials by means of pressure. The large sandstone syncline is confined by the garumnian marl sediments. Permeability is key for fissuration and fracturation. The aquifer recharge area is constituted by the sandstone periferial outcrops (Sant Corneli, Mitjana mountain range, Comiols, Montsec de Rúbies, where the aquifer is free). The aquifer discharge areas are, on top of the Basturs ponds, several springs and diffused drainage to the Abella, Conques and, ultimately, the Noguera Pallaresa and the Sant Antoni Dam.

The aquifer absorption surface is of circa 80 km^2. The available subterranean resources are of about 9 hm^3/year and they drain subterraneanly to different points. The Noguera Pallaresa discharge is estimated to be around 3.8 hm^3/year. The diffuse discharge of the Abella and Conques rivers is estimated to be around 3.5 hm^3/year and keeps the water in those rivers even during harsh summers. Extraction by documented wells and springs represent about 1 hm^3/year and through the Basturs ponds system some 0.4 hm^3/year surface (Pascual, 1992; Alonso & Marzán, 2006).

4. REPRESENTATIVE SOIL PROFILE DESCRIPTIONS

4.1. Soils developed over sediments originated from the Comiols conglomerates meteorization.

I. General description

The soils developed over sediments originated from the Comiols conglomerate meteorization are quite deep, well drained and of fine textures, with many coarse elements originated from the meteorization of these very same conglomerates.

The profile presents a quite dark superficial horizon (A or Ap), with very good structure and alkaline saturated, which creates a mollic horizon. Subsuperficial horizons show secondary generalised cumulations of calcium carbonate, which create a calcic horizon and clay cutans with coarse element coverings, which in turn create a clay horizon.

A typical horizon sequence for these soils is: Ap-Bwknt/Bkt.

The Ap horizon is about 30 cm. thick. Its colour (humid) is dark grey to reddish dark brow (7.5 YR 3/3 to 5YR 3/3). Its texture is loam or clayloam and features many coarse elements. The pH is moderately alkaline (8.3-8.4), carbonate content is moderately high to high (19-32) and organic matter content is low to mid (1.7% - 3.4%). The dark colours, strong structure and elevated contents of organic matter allow us to classify it as a mollic epipedion.

Underneath we find a succession of Bwknt/Bkt horizons which extend themselves until 120 cm. in depth. Its colour (humid) is light brown to red (7.5YR 4/6 a 2.5YR 4/8). Texture is clay-loamy and features many coarse elements. pH is moderately alkaline to slightly alkaline (8.4-8.9), carbonate content is high to very high (32-68), increasing as we go down in depth. We can find generalised cumulations of calcium carbonate, which give us a calcic horizon and clayish cutans coating those coarse elements, which render a Clay horizon.

These soils are classified as typical Calcixeroll, loamy fine, carbonate, mesic or typical Palexeroll, fine loamy, carbonate, mesic (SSS, 1999) and as calcic luvic Kastazonem (chromic) (IUSS, 2006).

II. Soil usage and vegetation

These soils are used for winter cereal cultivation or for forestry usages, as the big conglomerate blocks presence makes them not apt for cultivation purposes.

III. Pedió representatiu

El pedió representatiu és: ISO-5-008.

Informació general
Data descripció: 25/07/2008
Descriptors: A. Armengol / T. Baltierrez
Paratge: Covet
Municipi: Isona i Conca Dellà

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 341117
Coordenada Y (m): 4661080
Z (m): 827

Land use
Vegetació: Cereal
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Geomorfologia
Escala d'observació: Hectomètrica
Forma del relleu: Vessant ondulat
Modificació de la forma: No descrita
Dinàmica de la forma: Estable
Intensitat dels processos: No descrit
Tipus de pendent: Complexa
Morfologia local: Situat en una àrea convexa
Situació en el perfil: Meitat de la forma
Pendent general (%): 10-20
Pendent local (%): 5-10
Orientació: W
Longitud (m): 100

Material originari
Sediments detrítics terrígens.

Material subjacent
Sediments detrítics terrígens.

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): -
Dimensió mitja (cm): -
Naturalesa: -

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
>120 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Calcixeroll típic, franca fina, carbonàtica, mèsica

Classificació WRB (IUSS, 2007):
Kastanozem calcic luvic (cròmic)

Seqüència d'horitzons: Ap-Bwknt-Bkt1-Bkt2
Curs de cartografia de sòls (IEC-IGC, 2008)

Descripció perfil

000-030 cm Ap

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 5YR 3/3. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: Molts (15-35 %), de grava fina a blocs petits (0,2-30), arrodonits-esferoïdals, fragments de conglomerat. ESTRUCTURA: Moderada, en blocs subangulars, mitjana. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): Friable. SISTEMA RADICULAR: Normal. ASSAIGS DE CAMP (Resposta al HCl 11 %): Alta. LIMIT INFERIOR: Net, pla. **EPIPEDIÓ MÒL·LIC.**

030-070 cm Bwknt

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 2,5YR 4/8. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Franca. ELEMENTS GROSSOS: Molts (15-35 %), de grava mitja a blocs petits (2,0-30), arrodonits-esferoïdals, fragments de conglomerat. ESTRUCTURA: Dèbil, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: Molts (20-40%), nòduls, 5-15 mm, tous, de carbonat. ESTUDI DE SUPERFICIES: 10-50% revestiments generalitzats. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Càmeres. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Gradual, pla. **ENDOPEDIÓ CÀLCIC/ARGÍLIC.**

070-110 cm Bkt1

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 2,5YR 4/8. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoarenosa. ELEMENTS GROSSOS: Molts (15-35 %), de grava mitja a blocs petits (2,0-30), arrodonits-esferoïdals, fragments de conglomerat. ESTRUCTURA: Dèbil, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: Generalitzades de carbonat. ESTUDI DE SUPERFICIES: 10-50% revestiments generalitzats. SISTEMA RADICULAR: Normal. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Gradual, pla. **ENDOPEDIÓ CÀLCIC/ARGÍLIC.**

110-150/999 cm Bkt2

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 2,5YR 4/8. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoarenosa. ELEMENTS GROSSOS: Molts (15-35 %), de grava mitja a blocs petits (2,0-30), arrodonits-esferoïdals, fragments de conglomerat. ESTRUCTURA: Dèbil, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: Generalitzades de carbonat. ESTUDI DE SUPERFICIES: 10-50% revestiments generalitzats. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Càmeres. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. **ENDOPEDIÓ CÀLCIC/ARGÍLIC.**

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap	000-030	8.3	-	-	0.19	4.0	19	-	-
Bwkn	030-070	8.4	-	-	-	3.4	26	-	-
Bkt1	070-110	8.7	-	-	-	-	68	-	-
Bkt2	110-150/999	8.9	-	-	-	-	71	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
15-35	16	16	32	12	26	38	30	FAg
15-35	16	15	31	13	26	39	30	FAg
15-35	-	-	-	-	-	-	-	-
15-35	-	-	-	-	-	-	-	-

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^+	K^+	kPa	kPa	-33 kPa	-1500 kPa		
19.6	18.1	0.7	0.1	0.7	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.2. Vertic soils

I. General description

Vertic soils are very deep, well drained and made of fine to very fine textures, with quite scarce coarse elements. They have developed over the detritic sediments cumulated at the Tremp basin slopes and at some terraces in its fluvial system, from the meteorization of some Garumnian lutites (Higher Cretaceous/Paleocene) which contain expansive clays.

The profile shows, starting at a given deep, cracks and slikensides, which confer the soil a marked vertic character and, often some secondary calcium carbonate cumulations, in nodular form which, usually, don't quite fit the requirements of a calcic horizon.

The typical sequence in these soils is: Ap-(Bw(k))-Bwss(kn).

The Ap horizon has a 30 cm. thickness. Its colour (humid) is olive green to strong brown (2.5YR 5/6 to 7.5YR 4/5). The texture is silty clay loam or silt loamy and shows scarce coarse elements. pH is moderately alkaline to slightly alkaline (8.1-8.5), carbonate content is high (31-40) and organic matter is low to mid (1.7%-3.9%).

The Bw horizon, when it appears, has a 40 cm. thickness. Its colour (humid) is olive green to yellowish brown (2.5Y 6/6 to 10YR 4/6). The texture is silty clay loam or silt loamy and shows scarce coarse elements. pH is moderately alkaline to slightly alkaline (8.3-8.5) and the carbonate content, high to very high (36-48). Occasionally, some calcium carbonate secondary cumulations can be found, which create cambic horizons.

Underneath, a succession of Bwss(kn) horizons go until 120 cm. depth, Its colour (humid) is yellow to yellowish brown (2.5Y 5/8 to 10YR 5/6). The texture is silty clay loam or silt loamy. pH is moderately alkaline to slightly alkaline (8.5-8.9) and the carbonate content, high to very high (38-52). It shows many cracks and slikensides, which create a vertic horizon. Occasionally, calcium carbonate secondary cumulations can be found in the shape of nodules, which creates a cambic horizon or, at some spots, maybe even a calcic horizon.

These soils are classified as Chromic Hapoxerert , fine, mixed, mesic (Chromic Calcixerert, when cumulations allow calcic) (SSS, 1999) and as Haplic Vertixol (calcaric) (IUSS, 2006).

II. Soil usage and vegetation

These soils are basically used for winter cereals cultivation or almond tree cultivation.

III. Pedió representatiu

El pedió representatiu és: ISO-4-15

Informació general
Data descripció: 16/09/2008
Descriptors: J. Porta i L. Gonzáles
Paratge: Pla de Sianes
Municipi: Isona i Conca Dellà

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 334852
Coordenada Y (m): 4664455
Z (m): 494

Land use
Vegetació: Cereal
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Geomorfologia
Escala d'observació: Hectomètrica
Forma del relleu: Plana d'inundació
Modificació de la forma: -
Dinàmica de la forma: -
Intensitat dels processos: -
Tipus de pendent: -
Morfologia local: -
Situació en el perfil: -
Pendent general (%): 2-5
Pendent local (%): <2
Orientació: W
Longitud (m): -

Material originari
Sediments detrítics terrígens.

Material subjacent
Sediments detrítics terrígens.

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): -
Dimensió mitja (cm): -
Naturalesa: -

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
>120 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Haploxerert cròmic, fina, mesclada, mèsica.

Classificació WRB (IUSS, 2007):
Vertisòl hàplic (calcàric)

Seqüència d'horitzons: Ap-Bwss-Bw
Curs de cartografia de sòls (IEC-IGC, 2008)

Descripció perfil

000-020 cm Ap

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 10YR 5/4. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: Molt pocs (<1%). ESTRUCTURA: Primària: Forta, en blocs subangulars, mitjana. Secundària: Dèbil, en blocs subangular, fina. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): Friable. SISTEMA RADICULAR: Normal. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Abrupte per conreu, pla. **EPIPEDIÓ ÒCRIC.**

020-072 cm Bwss

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 10YR 4/4. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Argil·lollimosa. ELEMENTS GROSSOS: Molt pocs (<1%). ESTRUCTURA: Forta, prismàtica, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Extremadament ferms. ACUMULACIONS: No n'hi ha. ESTUDI DE SUPERFICIES: <10%, slikensides. SISTEMA RADICULAR: Limitat per un horitzó molt compacte. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Gradual, pla. OBSERVACIONS: Moltes esquerdes, d'orientació vertical, amplada modal 7 mm (màxim 10 mm) i longitud 100-120 cm. **ENDOPEDIÓ VÈRTIC.**

072-160/999 cm Bw

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 10YR 3/4. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Argil·lollimosa. ELEMENTS GROSSOS: Molt pocs (<1%). ESTRUCTURA: Molt forta, en blocs subangulars, mitjana. COMPACITAT: Molt Compacte. CONSISTÈNCIA (humit): Extremadament ferm. ACUMULACIONS: No n'hi ha. ESTUDI DE SUPERFICIES: No n'hi ha. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. OBSERVACIONS: Moltes esquerdes, d'orientació vertical, amplada modal 7 mm (màxim 10 mm) i longitud 100-120 cm.

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap	000-020	8.3	-	-	0.25	2.5	41	-	-
Bwkn	020-072	8.5	-	-	-	2.3	41	-	-
Bkt1	072-160	8.6	-	-	-	1.2	41	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
<1	4	7	11	13	39	52	37	FAgL
<1	3	6	9	12	37	49	42	AgL
<1	2	6	8	8	36	44	49	AgL

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	kPa	kPa	-33 kPa	-1500 kPa		
21	19	1	0	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.3. **Soils developed over travertines**

I. General description

The soils developed over travertines at the Tremp basin are very shallow, well drained and of medium textures, with few coarse elements, which usually are fragments of the same rock.

The profile shows little edaphological development.

The typical sequence of horizons for these soil is Ap-R(travertine).

The Ap horizon has 20 cm of thickness. Its colour (humid) is dark brown (7.5YR 4/4). The texture is loamy and it shows few coarse elements. pH is moderately alkaline (8.1-8.4), carbonate content is very high (45-82) and organic matter content is low to mid (1.6%-5.2%).

Underneath, travertines (R horizon) appear, their fractured state depending on whether they are used for cultivation or not.

These soils are classified as lythic Xerortent, loamy, carbonated, mesic (SSS, 1999) and as haplic Leptosoil (calcaric) (IUSS, 2007).

II. Soil usage and vegetation

These soils are mainly used to winter cereal cultivation or almond tree cultivation.

III. Pedió representatiu

El pedió representatiu és: ISO-1-11

Informació general
Data descripció: 23/08/2008
Descriptors: M.R. Teira
Paratge: Mont de Conques
Municipi: Isona i Conca Dellà

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 336305
Coordenada Y (m): 4667329
Z (m): 675

Land use
Vegetació: Ametllers
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Geomorfologia
Escala d'observació: Decamètrica
Forma del relleu: Plataforma
Modificació de la forma: -
Dinàmica de la forma: -
Intensitat dels processos: -
Tipus de pendent: -
Morfologia local: Situat en una àrea rectilínia
Situació en el perfil: En la meitat de la forma.
Pendent general (%): 2-5
Pendent local (%): 2-5
Orientació: NW
Longitud (m): -

Material originari
Sediments detrítics terrígens.

Material subjacent
Travertins.

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): 10-30%.
Dimensió mitja (cm): -
Naturalesa: Fragments de travertí i calcàries.

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
<20 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Xerortent lític, franca, carbonàtica, mèsica.

Classificació WRB (IUSS, 2007):
Leptoxòl hàplic (calcàric)

Seqüència d'horitzons: Ap-B/R-R(travertí)
Curs de cartografia de sòls (IEC-IGC, 2008)

Descripció perfil

000-020 cm Ap

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 7,5YR 4/4. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Franca. ELEMENTS GROSSOS: Pocs (1-5%), fragments de travertí i calcàries. ESTRUCTURA: Dèbil, granular composta. COMPACITAT: No coherent. CONSISTÈNCIA (sec): Solt. LIMIT INFERIOR: Abrupte per conreu, pla. **EPIPEDIÓ ÒCRIC.**

020-050 cm B/R

050-055/999 cm R (travertí)

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap	000-020	8.3	-	-	0.3	2.7	72	-	-
B/R	020-050	8.4	-	-	-	1.5	82	-	-
R (travertí)	050-055	-	-	-	-	-	-	-	-

Elements grossos (%)	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila	Classe Textural
Ø >2 mm	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL	Ø < 0.002 mm	USDA
1-5	28	17	45	13	21	34	21	F
1-5	35	23	58	10	9	19	23	FAgAR
-	-	-	-	-	-	-	-	-

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^+	K^+	kPa	kPa	-33 kPa	-1500 kPa		
10	8	1	0	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.4. **Soils developed over travertines, in slope facies and over the old ponds from the Mont de Conques travertine complex**

I. General description

Soils developed over travertines, in slope facies and over the old ponds from the Mont de Conques travertine complex are very deep, well drained and of medium texture, with few coarse elements.

The profile shows generalised secondary calcium carbonate cumulations which render a calcic horizon (hypercalcic according to WRB).

The typical horizon sequence of these soils is A(p)-(Bw)-Bk.

A(p) horizon has a 20 to 30 cm. thickness. Its colour (humid) is dark brown (5YR 4/4-6). The texture is loamy or clay-loamy and shows few coarse elements. pH is moderately alkaline (8.1-8.5), carbonate content is very high (40-45) and organic matter content is low to mid (2.0% - 3.7%).

The Bw horizon, when it appears, has a 30 cm. thickness. Its colour (humid) is strong brown to reddish brown (10YR 2/4 to 7.5YR 4/6). Its texture is loamy or silty clay loam and shows few coarse elements. pH is slightly alkaline (8.5-8.7) and its carbonate content very high (40-47). It shows secondary calcium carbonate cumulations, of diverse morphology, which render a calcic horizon.

Underneath, we find the Bk horizon. This is a calcium carbonate cumulation horizon, from the saturated waters coming from the ancient ponds. Its colour (humid) is faint orange (7.5YR 8/3). Its texture is loamy and shows few coarse elements. pH is slightly alkaline (8.5-8.7) and the carbonate content very high (70-78). This is a calcic horizon (SSS, 1999) (hypercalcic, WRB, 2007).

These soils are classified as typical Calcixerept, coarse loamy, carbonate, mesic (SSS, 1999) and as Hypercalcic Calcisoil (IUSS, 2007).

II. Soil Usage and vegetation

These soils, when not used for livestock breeding, are mainly used for winter cereal cultivations or almond tree cultivations.

III. Pedió representatiu

El pedió representatiu és: ISO-4-020

Informació general
Data descripció: 28/07/2008
Descriptors: F. Fonseca i J. Pujades
Paratge: Mont de Conques
Municipi: Isona i Conca Dellà

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 334145
Coordenada Y (m): 4665755
Z (m): 541

Land use
Vegetació: Ametllers
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Geomorfologia
Escala d'observació: Decamètrica
Forma del relleu: Vessant
Modificació de la forma: -
Dinàmica de la forma: -
Intensitat dels processos: -
Tipus de pendent: -
Morfologia local: Situat en una àrea còncava
Situació en el perfil: -
Pendent general (%): 5-10
Pendent local (%): -
Orientació: -
Longitud (m): -

Material originari
Sediments detrítics rics en carbonat.

Material subjacent
graves.

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): -.
Dimensió mitja (cm): -
Naturalesa: -

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
>120 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Calcixerept típic, franca grossa, carbonàtica, mèsica.

Classificació WRB (IUSS, 2007):
Calcisòl hipercàlcic

Seqüència d'horitzons: Ap-Bw-Bk
Curs de cartografia de sòls (IEC-IGC, 2008)

Descripció perfil

000-014 cm Ap

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 5YR 4/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: Pocs (1-5%). ESTRUCTURA: Moderada, granular composta, mitjana. COMPACITAT: Poc compacte. CONSISTÈNCIA (sec): Lleugerament dur. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers ASSAIGS DE CAMP (Resposta al HCl 11 %): Alta. LIMIT INFERIOR: Net, pla. **EPIPEDIÓ ÒCRIC.**

014-031 cm Ap2

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 5YR 5/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoargilosa. ELEMENTS GROSSOS: Pocs (1-5 %). ESTRUCTURA: Forta, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (sec): Lleugerament dur. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Alta. LIMIT INFERIOR: Net, pla. **EPIPEDIÓ ÒCRIC.**

031-050 cm BwK

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 7,5YR 4/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: -. ELEMENTS GROSSOS: Pocs (1-5 %). ESTRUCTURA: Moderada, en blocs subangulars, mitjana. COMPACITAT: Poc compacte. CONSISTÈNCIA (sec): Lleugerament dur. ACUMULACIONS: moltes (20-40%). SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Net, ondulat. **ENDOPEDIÓ CÀLCIC.**

050-088 cm BK (graves)

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 7,5YR 8/3. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: -. ELEMENTS GROSSOS: Abundants (35-70 %). ESTRUCTURA: sense estructura per abundància d'elements grossos. ACUMULACIONS: generalitzades de carbonat càlcic. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. **ENDOPEDIÓ CÀLCIC.**

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap1	000-014	8.3	-	-	0.3	3.8	40	-	-
Ap2	014-031	8.6	-	-	-	-	44	-	-
Bwk	031-050	8.7	-	-	-	-	43		
Ck (graves)	051-088	78	-	-	-	-	78	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
1-5	7	11	18	15	33	48	34	FAgL
1-5	14	11	25	13	32	45	30	FAg
1-5								
35-70	-	-	-	-	-	-	-	-

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	kPa	kPa	-33 kPa	-1500 kPa		
21	19	1	0	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.5. **Soils developed over sediments from the Areny sandstones' meteorization**

I. General description

Soils developed over sediments from the Areny sandstones meteorization are very deep, well drained and of coarse texture, with few coarse elements.

The profile shows abundant continuous argillans associated to sand grains and pores which render argillaceous horizons and starting at given depths, pseudomycelliums, coated root channels and calcite rizoconcretions that give place to Calcic horizons.

The typical horizon sequence in these soils is (A(p))-Bwt-Bwknt.

A(p) horizon has a 20 to 30 cm thickness. Its colour (humid) is red (2.5YR 4/4-6). Its texture is sandy or loamy sand. pH is neuter to moderately alkaline (7.1-8.2), carbonate content is very low and organic matter content is low (0.4%-1.1%).

Underneath, a succession of Bwt horizons that stretch to 100 cm in depth appear. Their colour (humid) is yellowish red to red (5YR 5/6 to 2.5YR 5/8). Its texture is loamy sand, sandy loam or sandy clay loam and shows very few coarse elements. pH is moderately acidic to neuter (5.9-7.2) and carbonate content is void to very low. They show continuous argillans associated to sand grains and pores and they give us an argillaceous horizon.

Underneath, a succession of Bwknt horizons appear. Their colour (humid) is yellowish red to orangey (5YR 5/6-8). The texture is sandy to sandy loam and show very few coarse elements. pH is moderately alkaline to slightly alkaline (8.3-8.5) and carbonate content is very low (4-5%). It shows secondary calcium carbonate cumulations in the shape of pseudomycelliums, coated root channels and rizoconcretions that give place to Calcic horizons.

These soils are classified as Calcic Haploxeralf, sand, mixed, mesic. (SSS, 1999) and as Calcic Luvisoil (arenic, rhodic).(IUSS, 2007).

II. Soil usage and vegetation

These soils are used for winter cereal cultivation and almond tree cultivation.

III. Pedió representatiu

El pedió representatiu és: TRMP-004

Informació general
Data descripció: 29/06/2014
Descriptors: E. Ascaso
Paratge: Nerets
Municipi: Tremp

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 329705
Coordenada Y (m): 4669597
Z (m): 577

Land use
Vegetació: Matoll
Usos del sòl: Extraccions
Tecnologia de sòls: -

Geomorfologia
Escala d'observació: Decamètrica
Forma del relleu: Vessant
Modificació de la forma: -
Dinàmica de la forma: Erosió laminar
Intensitat dels processos: Moderada
Tipus de pendent: Simple
Morfologia local: Situat en una àrea rectilinia
Situació en el perfil: Vora inferior de la forma
Pendent general (%): 5-10
Pendent local (%): 5 - 10
Orientació: S
Longitud (m): 200

Material originari
Sediments detrítics terrígens.

Material subjacent
Sediments detrítics terrígens

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): -
Dimensió mitja (cm): -
Naturalesa: -

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

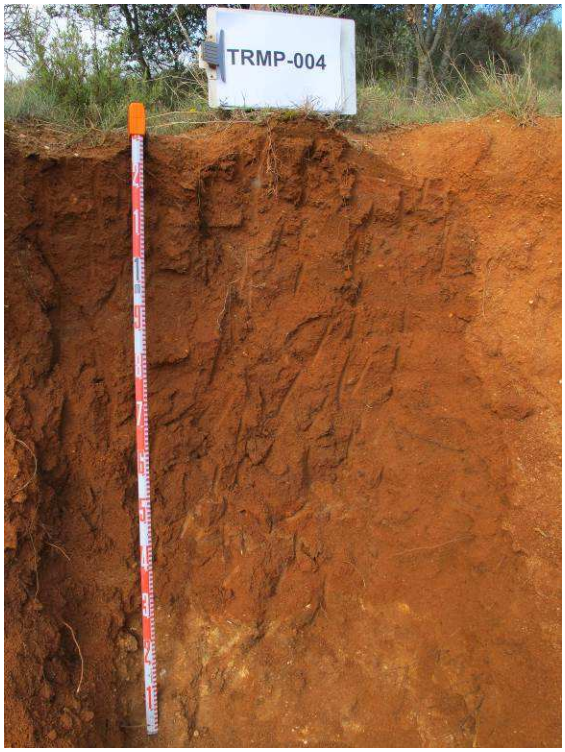
Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
> 120 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Haploxeralf càlcic, arenosa, mesclada, mèsica.

Classificació WRB (IUSS, 2007):
Luvisòl càlcic (arènic, ròdic)



Seqüència d'horitzons: Ap-Bwt-Bwknt
Curs d'estiu de la Universitat de Lleida, 2014

Descripció perfil

000-015 cm A

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 2,5YR 4/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Arenofranca. ELEMENTS GROSSOS: Pocs (1-5 %), grava mitja (0,6-2,0 cm), arrodonida, esferoïdal, quars. ESTRUCTURA: Dèbil, en blocs subangulars, mitjana. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): molt friable. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Dèbil. LIMIT INFERIOR: Net, pla. **EPIPEDIÓ ÒCRIC.**

015-070 cm Bwt1

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 5YR 5/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoarenosa. ELEMENTS GROSSOS: Pocs (1-5 %), grava mitja (0,6-2,0 cm), arrodonida-esferoïdal, quars. ESTRUCTURA: Moderada, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ESTUDI DE SUPERFÍCIES: Molts (10-50%), argilans associats als grans d'arena i als porus. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Nul·la. LIMIT INFERIOR: Net, pla. **ENDOPEDIÓ ARGÍLIC.**

070-097 cm Bwt2

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 5YR 5/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoarenosa. ELEMENTS GROSSOS: Pocs (1-5 %), grava mitja (0,6-2,0 cm), arrodonida-esferoïdal, quars. ESTRUCTURA: Moderada, en blocs subangulars, mitjana. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ESTUDI DE SUPERFÍCIES: Abundants (50-80%), argilans associats als grans d'arena i als porus. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Nul·la. LIMIT INFERIOR: Net, pla. **ENDOPEDIÓ ARGÍLIC.**

070-097 cm Bwknt

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 5YR 5/6. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Arenosa. ELEMENTS GROSSOS: Pocs (1-5 %), grava mitja (0,6-2,0 cm), arrodonida-esferoïdal, quars. ESTRUCTURA: Molt dèbil, en blocs subangulars, grossa. COMPACITAT: Molt compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: Alguns (5-20%), pseudomicel·lis de carbonat. ESTUDI DE SUPERFÍCIES: Pocs (<10%), argilans associats als grans d'arena i als porus. SISTEMA RADICULAR: Normal. ACTIVITAT BIOLÒGICA: Formiguers. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. **ENDOPEDIÓ CÀLCIC.**

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
A	000-015	-	-	-	-	-	-	-	-
Bwt1	015-070	-	-	-	-	-	-	-	-
Bwt2	070-097	-	-	-	-	-	-	-	-
Bwknt	097-130/999	-	-	-	-	-	-	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
1-5	-	-	-	-	-	-	-	-
1-5	-	-	-	-	-	-	-	-
1-5								
1-5	-	-	-	-	-	-	-	-

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^+	K^+	kPa	kPa	-33 kPa	-1500 kPa		
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.6. **Soils with petrocalcic horizons, developed over residual alluvial fans**

I. General description

Soils with petrocalcic horizons, developed over residual alluvial fans at the Tremp basin are quite shallow, well drained and of medium textures, with many coarse elements.

The profile shows secondary calcium carbonate cumulations that, before 40 cm in depth, cement the gravels and give a petrocalcic horizon.

The typical horizon sequence in these soils is Ap-(Bwkn)-Bkm-Bk.

The Ap horizon has a 20 to cm cm thickness. Its colour (humid) is yellowish brown to strong brown (10YR 4/3 to 7.5YR 5/6). The texture is loamy or clay loam and shows many coarse elements (15-35%). pH is moderately alkaline to slightly alkaline (8.0-8.5), carbonate content is very high (41-66%) and organic matter content is mid to abundant (2.0% - 7.3%).

The Bwkn horizon, when it appears, has a 20 cm. thickness. Its colour (humid) is yellowish brown to strong brown (10YR 4/3 to 7.5YR 5/6). The texture is loamy and shows many coarse elements (15-35%). pH is moderately alkaline to slightly alkaline (8.3-8.7) and carbonate content is very high (44-66%).

The Bkm horizon has a variable thickness. It is formed by a cemented layer of gravels and sands, due to the action of the calcium carbonate, which render a petrocalcic horizon. The cementation grade in this horizon is variable, although it usually is lower as we go deeper in depth. On top of that, we often find it fractured by the effect of the subsoils and other agricultural tasks.

Underneath, we find a succession of Bk horizons made from abundant gravels and pebbles of calcareous nature that show secondary carbonate cumulations in the shape of coating and geopetal cement, which render a calcic horizon. Those horizons show areas with a certain degree of cementation, but overall it's far weaker than on the superficial horizon. The matrix presents a colour (humid) from pale orange to pinkish white (7.5YR 7-8/2/4) and with a loamy or sand loam texture.

These soils are classified as Petrocalcic Calcixerept, loam, carbonate, mesic. (SSS, 1999) and as Petric Calcisoil (IUSS, 2007)

II. Soil usage and vegetation

These soils are used for almond tree cultivation and vineyard cultivation.

III. Pedió representatiu

El pedió representatiu és: PJU-008.

Informació general
Data descripció: 26/06/2009
Descriptors: A. Armengol / M. Maneu
Paratge: Vinyes de Sant Miquel
Municipi: Tremp

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 322276
Coordenada Y (m): 4675423
Z (m): 942

Land use
Vegetació: Cultiu
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Geomorfologia
Escala d'observació: Hectomètrica
Forma del relleu: Vessant rectili
Modificació de la forma: -
Dinàmica de la forma: -
Intensitat dels processos: -
Tipus de pendent: Simple
Morfologia local: Situat en una àrea rectilínia
Situació en el perfil: Meitat superior de la forma
Pendent general (%): 10-20
Pendent local (%): 10-20
Orientació: SE
Longitud (m): -

Material originari
Sediments detrítics terrígens amb còdols.

Material subjacent
Sediments detrítics terrígens amb còdols.

Elements grossos
Abundància (%): 30-70%
Dimensió mitja (cm): 6-15 cm
Naturalesa: còdols de conglomerat

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
< 40 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Calcixerept petrocàlcic, franca, carbonàtica, mèsica

Classificació WRB (IUSS, 2007):
Calcisòl pètric

Seqüència d'horitzons: Ap-Bkm-Bk

Mapa de sòls 1:250.000 de la comarca del Pallars Jussà (ICGC, 2010)

Descripció perfil

000-015/020 cm A

EST. HUMITAT: Sec. COLOR DE LA MATRIU (Humit): 10YR 3/4. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoarenosa. ELEMENTS GROSSOS: Abundants (35-70 %), de grava grossa (2,0-6,0), arrodonits-esferoïdals, fragments de conglomerat. ESTRUCTURA: Moderada, en blocs subangulars, fina. COMPACITAT: Poc compacte. CONSISTÈNCIA (sec): Lleugerament dur. ACUMULACIONS: Molt poc, ciment geopetal, tou, de carbonat càlcic. SISTEMA RADICULAR: Limitat per horitzó cimentat. ASSAIGS DE CAMP (Resposta al HCl 11 %): Molt alta. LIMIT INFERIOR: Abrupte, pla. **EPIPEDIÓ ÒCRIC.**

015/020-040 cm Bkm

CIMENTACIÓ: Moderadament cimentat
ENDOPEDIÓ PETROCÀLCIC

040-150/999 cm Bk

ENDOPEDIÓ CÀLCIC

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap	000-015/020	8.1	-	-	0.2	6.0	50	-	-
Bkm	015/020-040	-	-	-	-	-	-	-	-
Bk	040-150	-	-	-	-	-	-	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
35-70	14	21	35	18	18	36	29	FAg
-	-	-	-	-	-	-	-	-
>70	-	-	-	-	-	-	-	-

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^+	K^+	kPa	kPa	-33 kPa	-1500 kPa		
12.6	10.9	0.9	0.1	0.7	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

4.7. Soils developed over colluvium mantled slopes

I. General description

Soils developed over colluvium mantled slopes are quite deep, well drained and have textures which range from moderately fine to fine, with few coarse elements.

The profile presents secondary calcium carbonate cumulations that usually give a calcic horizon.

The typical horizon sequence is Ap-Bwkn.

The Ap horizon has a 30 to 40 cm thickness. Its colour (humid) is dark yellowish brown to orange (10YR 4/6 to 7.5YR 5-6/6-8). The texture is silty clay loam to clay loam and shows few coarse elements (<1%). pH is moderately alkaline to slightly alkaline (8.2-8.6), carbonate content is high to very high (34-51%) and organic matter is low to mid (1.6%-2.3%).

Underneath we find a succession of Bwkn horizons that can reach 120 cm in depth. Its colour (humid) is orange to orange red (7.5YR 5+6/8 to 2.5YR 6/6). The texture is silty clay loam, clay loam or silt loam and shows few coarse elements (<1%). pH is slightly alkaline and carbonate content very high (43-61%). It shows secondary calcium carbonate cumulations of nodular form that usually give a calcic horizon.

These soils classify as Typical Calcixerept, fine silty, carbonate, mesic (SSS, 1999) and as Haplic Calcisoil (WRB, 2007).

II. Soil usage and vegetation

These soils are used for cereal cultivation.

III. Pedió representatiu

El pedió representatiu és: ISO-4-001.

Informació general
Data descripció: 29/07/2008
Descriptors: F. Fonseca / J. Pujades
Paratge: els Obacs de Llimiana
Municipi: Llimiana

Cartografia
Sistema de projecció (ED50): UTM
Fus: 31
Coordenada X (m): 333257
Coordenada Y (m): 4661111
Z (m): 828

Land use
Vegetació: Cultiu
Usos del sòl: Agrícola
Tecnologia de sòls: Secà sense drenatge

Geomorfologia
Escala d'observació: Hectomètrica
Forma del relleu: Vessant rectili
Modificació de la forma: -
Dinàmica de la forma: -
Intensitat dels processos: -
Tipus de pendent: Simple
Morfologia local: Situat en una àrea còncava
Situació en el perfil: Meitat superior de la forma
Pendent general (%): -
Pendent local (%): 10-20
Orientació: -
Longitud (m): -

Material originari
Sediments detrítics terrígens.

Material subjacent
Sediments detrítics terrígens.

Afloraments
Abundància (%): -
Distància mitja (m): -
Naturalesa: -

Elements grossos
Abundància (%): -
Dimensió mitja (cm): -
Naturalesa: -

Crosta superficial
Gruix: -
Consistència: -

Clivellat superficial
Amplada (cm): No existents
Distància mitja: -

Salinitat
No salí (<2 dS/m a 25ºC)

Profunditat efectiva d'arrelament
> 120 cm

Aigua del sòl
Classe de drenatge: Ben drenat
Estat d'humitat: Lleugerament humit
Nivell freàtic (cm): Inaccessible

Classificació *Soil taxonomy* (SSS, 1999):
Calcixerept típic, llimosa fina, carbonàtica, mèsica

Classificació WRB (IUSS, 2007):
Calcisòl hàplic (cròmic)

Seqüència d'horitzons: Ap1-Ap2-Bwkn1-Bwkn2-Bwkn3
Curs de cartografia de sòls (IEC-IGC, 2008)

Descripció perfil

000-009 Ap1

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (Humit): 7,5YR 6/8. EST. OXIDOREDUCCIÓ: En estat d'oxidació. TAQUES: No n'hi ha. TEXTURA: Francoargilosa. ELEMENTS GROSSOS: No n'hi ha. ESTRUCTURA: Forta, en blocs subangulars. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): Friable. SISTEMA RADICULAR: Limitat per horitzó cimentat. ASSAIGS DE CAMP (Resposta al HCl 11 %): Alta. LIMIT INFERIOR: Abrupte per conreu. **EPIPEDIÓ ÒCRIC.**

009-017 Ap2

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (humit): 7,5YR 5/6. EST. OXIDOREDUCCIÓ: Oxidat. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: No n'hi ha. ESTRUCTURA: Forta, en blocs subangulars. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): Friable. SISTEMA RADICULAR: Normal. ASSAIG DE CAMP: A la matriu, l'HCl (11%): Alta. AMPLITUD DEL LÍMIT: Abrupte per conreu. **EPIPÈDON: ÒCHRIC**.

017-116 Bwkn

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (humit): 7,5YR 6/8. EST. OXIDOREDUCCIÓ: Oxidat. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: No n'hi ha. ESTRUCTURA: Moderada, en blocs subangulars. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: abundants (>40%), en forma de nòduls. SISTEMA RADICULAR: Normal. ASSAIG DE CAMP: A la matriu, l'HCl (11%): Alta. AMPLITUD DEL LÍMIT: Difús. **ENDOPÈDON: CÀLCIC**.

116-147 Bkn

EST. HUMITAT: Lleugerament humit. COLOR DE LA MATRIU (humit): 7,5YR 5/8. EST. OXIDOREDUCCIÓ: Oxidat. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: 5-15%. ESTRUCTURA: Moderada, en blocs subangulars. COMPACITAT: Compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: Abundants (>40%), en forma de nòduls. SISTEMA RADICULAR: Normal. ASSAIG DE CAMP: A la matriu, l'HCl (11%): Alta. **ENDOPÈDON: CÀLCIC**.

147-197/999 Ckn

EST. HUMITAT: Humit. COLOR DE LA MATRIU (humit): 7,5YR 5/8. EST. OXIDOREDUCCIÓ: Oxidat. TAQUES: No n'hi ha. TEXTURA: Francoargil·lollimosa. ELEMENTS GROSSOS: No n'hi ha. ESTRUCTURA: Moderada, en blocs subangulars. COMPACITAT: Poc compacte. CONSISTÈNCIA (humit): Friable. ACUMULACIONS: 20-40%, en forma de nòduls. SISTEMA RADICULAR: Normal. ASSAIG DE CAMP: A la matriu, l'HCl (11%): Alta. **ENDOPÈDON: CÀLCIC**.

Resultats analítics

Horitzó genètic	Profunditats	pH			CE 1:5 (dS/m a 25 ºC)	Matèria orgànica (%)	Carbonat càlcic eq.(%)	Calcària activa (%)	Guix (%)
		H_2O 1:2,5	KCl 0.1M 1:2,5	Pasta saturada					
Ap1	000-009	8.4	-	-	0.16	1.9	39	-	-
Ap2	009-017	8.6	-	-	-	1.5	43	-	-
Bwkn	017-116	8.8	-	-	-	0.4	48	-	-
Bkn	116-147	8.8	-	-	-	0.2	43	-	-
Ckn	147-197	8.7	-	-	-	0.3	45	-	-

Elements grossos (%) Ø >2 mm	Granulometria (%)							
	Arena (Ø en mm)			Llim (Ø en mm)			Argila Ø < 0.002 mm	Classe Textural USDA
	2.00-0,2	0,2- 0,05	TOTAL	0,05-0,02	0,02-0,002	TOTAL		
No n'hi ha	9	14	23	16	32	48	30	FAg
No n'hi ha	6	11	16	16	37	53	30	FAgL
No n'hi ha	1	9	10	8	49	57	34	FAgL
5-15	1	6	6	16	47	63	30	FAgL
No n'hi ha	3	13	13	17	39	56	31	FAgL

Complex de canvi					Humitat					
CIC cmol(+)/kg	Cations de canvi cmol(+)/kg				Humitat gravimètrica (%) a				Aigua disponible (mm)	Densitat aparent (kg/m^3)
	(*)Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	kPa	kPa	-33 kPa	-1500 kPa		
16.0	15.3	0.4	0.1	0.2	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

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