Annex nº2
GEOLOGICAL HERITAGE

Preface

The geological heritage interest of Molina and Alto Tajo is based primarily on three factors:

- A large continuous sedimentary series, ranging from the Ordovician to the present with little stratigraphic gaps and where major events are recorded in the last 400 million years of earth history.
- A network of rivers that have shaped canyons, exposing this sedimentary series.
- The scarcity of population, infrastructure and industrial development have preserved geological heritage in optimal conditions for study.

B1. Location of the proposed Geopark

Figure10. Location of Molina and high Tajo Aspirant Geopark

GEOGRAPHIC COORDINATES:
Longitude: W from 2 ° 24 '45 "W 1 till 32' 40"
Latitude: from N 41 º 10 '16 "N 40 º 24 till' 23"

B2. Geological general description of proposed Geopark

B.2.1. Geologic and geographic framework of the area.

With respect to geological framework, de Molina-Alto Tajo, is situated in the Castilian Branch of Iberian Range. The materials from which the geology of this region are mostly Mesozoic, although there are also materials Palaeozoic and Cenozoic. Outcrops of **Palaeozoic materials** appear discontinuously forming a series of “massif”. These outcrops whose orientation is NW-SE, are restricted to the nucleus of large structures of Castilian Branch of the Iberian Range. From a cronostratigraphic point of view these materials exhibit some ages ranging from the Ordovician to the Permian. The main materials are slate and quartzite. .

As **Mesozoic materials**, make up the biggest part of the geology of the region of Molina and even large part of the province of Guadalajara. Triassic and Jurassic materials outcropping in the region are represented by a succession of clastic and carbonate interbedded with marly rocks units formed in continental environments and marine. These materials continue NW orientation structures generated during the compressive phase of the Range (Gomez and Canales, 2008). The Cretaceous of the Comarca de Molina is located in the SW and NE in the region. The outcrops of this period consist mainly of carbonate rocks (limestone and dolomite) and marl. Over this Mesozoic materials are arranged discordant Neogene outcrops of small extension. Overall, the Shire of Molina is characterized by a remarkable geodiversity, highlighting the presence of important stratigraphic series of great continuity. In addition, is remarkable the tectonic lithological and geomorphologic variety and present throughout the area, including also very fossiliferous levels of different ages. .

This region is also noted for its biodiversity. The vegetation of the southern valleys in the Alto Tajo canyon are slopes covered by forests of black pine and Scots pine. These are natural forests that have spread favoured by human action, which took the opportunity to use the timber. On sandstone and other siliceous fields are extending masses of resinous pine, also extended by human action, traditionally used for resin. These pines have un interesting pyrenean oak and rockrose understory, consolidated following the abandonment of the resin activity in recent times. Outside the area of influence of the canyon, on the moorlands rise juniperous (Which here, as in most of its range, appears in a feature of open stands structure) and Scots pine. In the moorlands whose altitude exceeds 1500 m. creeping juniper appear, alternating or interleaved with masses of pine. This peculiar landscape receives the name of "leopard skin". The floristic catalogue of Natural Park Alto Tajo reaches the 1,500 species and subspecies of vascular plants, which comes to represent 18% of all existing in Iberian Peninsula and the Balearic territory. Approximately seventy are officially listed in Castilla-La Mancha as threatened, some even as "endangered", such as *Atropa baetica*. As the fauna includes a total of 124 species of birds, 42 mammals, 15 reptiles, 9 amphibians and 10 fish species. The Alto Tajo distinguished by its community of cliff-nesting birds. The cliffs of the river canyons are used by one of the largest European populations of vultures, estimated at more than 900 pairs. They also use these cliffs to breed species as significant as the vulture, golden eagle, Bonelli's eagle, short-toed eagle, the pilgrim hawk, owls and chough among others. Another animal community of interest is that associated with the rivers, so rapid and general well-oxygenated waters in this natural region. The native trout fish is the jewel of these habitats, like the otter, which is here one of his best Iberian populations. The Comarca de Molina is one of the last refuges for native crayfish, on the verge of extinction in Spain. Finally, in forests and thickets retreats good number of animals, many of them favoured by the abandonment of rural areas. Wild boar, roe deer, wild goats, foxes, badgers, bobcats, martens, genets, booted eagles, buzzards, owls, owls, and many species of small birds, are some of these inhabitants in forest environments. One of the main natural attractions of this area is the close relationship between geodiversity and biodiversity. The incredible biodiversity of the Shire of Molina is absolutely conditioned by geodiversity, and may establish unique associations between bio and geodiversity, something that is of great interest to the visitor side. .

B.2.2. General geological description

The Shire of Molina and Alto Tajo are part of the Iberian Range, one of the main items forming the Iberian Peninsula (Fig. 11).
Below is a description lithologic summary of the geology of the region of the territory of Molina-Alto Tajo based on a review of several studies conducted by various authors throughout the area (see annex 8).

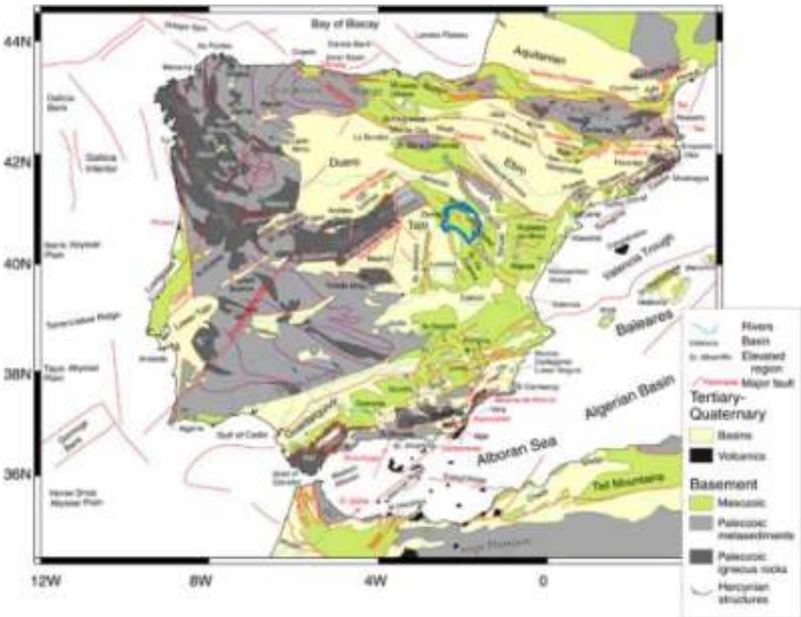

Fig.11. Main geological units Iberian and location of the Shire of Molina and Alto Tajo.

Paleozoic
The outcropping pre-carboniferous rocks are scattered and constitute a series of Palaeozoic massifs. These are isolated outcrops whose orientation goes along NO-SE, and are attached to a core within larger structures of the Castilian branch of the Iberian range. These rocks belong to the SE prolongation of the western Asturian–Leonese area, which does not crop up again until the provinces of Guadalajara, Teruel and Zaragoza. (Gutiérrez Marco *et al.*, 2008) (Fig 12). The aforementioned outcrops appear somewhat deformed and have a low metamorphic degree, which facilitates its research. These outcrops, along with slates, another prominent material we can find are quartzites.

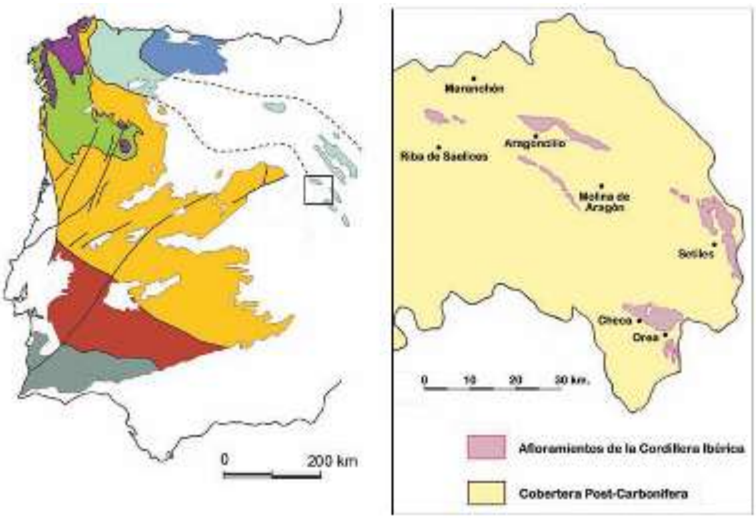

Fig.12. Location of pre-Carboniferous outcrops in the province of Guadalajara and its relation to the extension of Zone Asturoccidental - Leon (blue). (Modified from Gutiérrez Marco et al., 2008).

The oldest rocks we can find in the research area belong to lower Ordovician, roughly speaking, the Ordovician–Silurian series in this zone is made up seven formations (Fig 13). The earliest outcropping rocks sometimes aged as Cambrian, mainly comprising quartzites and slates. On top of these rocks the **Armorican quartzites Formation** lies unconformably, which in this area, reaches more than 400 meters thick. This formation is mainly constituted by thick layers of quartzites with interbedded sandstones and shales. Concordant upon the Armorican Quartzite middle Ordovician continues with **Villar del Saz Formation**, which basal member is characterized by the presence of slates y grawaques, **San Marcos Formation** stands on top of this unit, it is made of two quartzite members separated by an intermediate layer of slates which separates middle and upper Ordovician. Continuing, in a concordant way or upon a stratigraphic gap, the **Ojos Negros Formation**, mainly formed by massive dolomites, preceded by a small member of green shales or marls. The top of this succession is marked by an erosive discontinuity, linked to al eustatic descent related with the glaciations which took place at the end of the Ordovician. Upon this discontinuity there are rocks from the Orea Formation, made up of granulated detritic sediments and pebbles of glaciomarine origin (Fortuin, 1984 en Gutiérrez *et al*., 2008). Finally, on top of the Orea Formation rocks there are quarzites from **Los Puertos Formation**, in which we can find the limit between Ordovician and Silurian.

The start of the Silurian series is marked by a succession of black shales with some stretches studded with nodules, which shape **Bádenas Formation**. The upper part of this formation only arises in nucleus of Ciruelos-Teroleja and Nevera massif, where we may find stretches made up of sandstones y ferruguinous quartzites that reach up Pridoli, albeit this zone, in general, from upper Silurian, the geologic record appears incomplete as the rocks belonging to Devonian and to Carboniferous suffer a strong erosion (Gutiérrez-Marco *et al.*, 2008).

Permian in Molina–Alto Tajo área is somewhat scanty, though appearing significally in certain points, as it is the case in Sierra de Aragoncillo. Stratigraphic succession starts with the **Capas de la Ermita Formation**, of autunien age and made up in three lithologic layers (Sopeña y Sánchez-Moya, 2008), out of which, the first appears discordantly on top of the rocks from lower Palaeozoic. This first section is mainly constituted by volcanic rocks. The next section presents an irregular alternation of shales and sandstones with dolomites. The end of the succession is mainly formed by limestones and dolomites with layers of lutites. Apart from this, this unit is characterized by well preserved **silicified trunks**, which are located on the volcanic rocks belonging to the first stretch of Permian rocks.

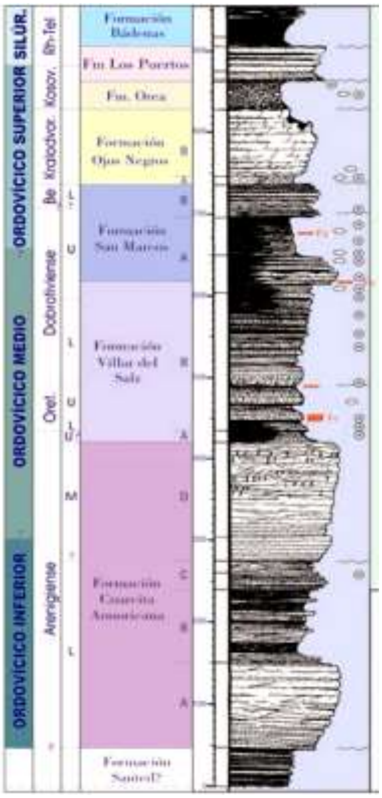

Figure 13. Stratigrafic column of the lower Palaeozoic sequence

On the above materials and forming discontinuous band going from Santa Maria del Espino to Sierra de Caldereros appears the **Montesoro Formation** corresponding to Saxonian stage and consists of a series of materials that evolve from detritic conglomerates to shales in intense reds and have been interpreted as alluvial fan sediments deposited in extremely arid climate.

Mesozoic

Mesozoic rocks are prominent in this region. The earliest rocks belonging to Triassic are discordantly on top of "Capas de la Ermita Formation", within the Sierra de Aragoncillo region (Sopeña y Sánchez-Moya, 2008; and Ramos, 1980) (See fig. 14).

Triassic

The Triassic materials of this area corresponding with the tree sedimentary Germanic facies: Buntsandstein, Muschelkalc and Keuper. Fig.15

In the area of "Hoz del Río Gallo" and "Barranco del Arrollo Viejo" are located one of the best outcrops of **Buntsandstein facies** and where is established the reference units the compound the "Guadalajara Group" formed by five formation:

- The first materials constitute the unit **Conglomerates of the Hoz del Gallo Formation**. This unit contains the limit Palaeozoic-Mesozoic.
- Following in sedimentary continuity there are the **Sandstones of Rillo de Gallo Formation**, with major crossed stratification in sandstones and some siltstone levels.
- On top of these rocks there is the "**Nivel de Prados" Formation"** mainly comprised by an alternation of siltstones and sandstones (arkoses).
- Concordant with these rocks there´s a sandstones, the **Sandstones of Arandilla´s River Formation**. Then the alternation between the sandstones and siltstones level becomes more frequent.
- This new layout of lithologies constitutes what is known as **Siltstones and Sandstones of Torete Formation**.

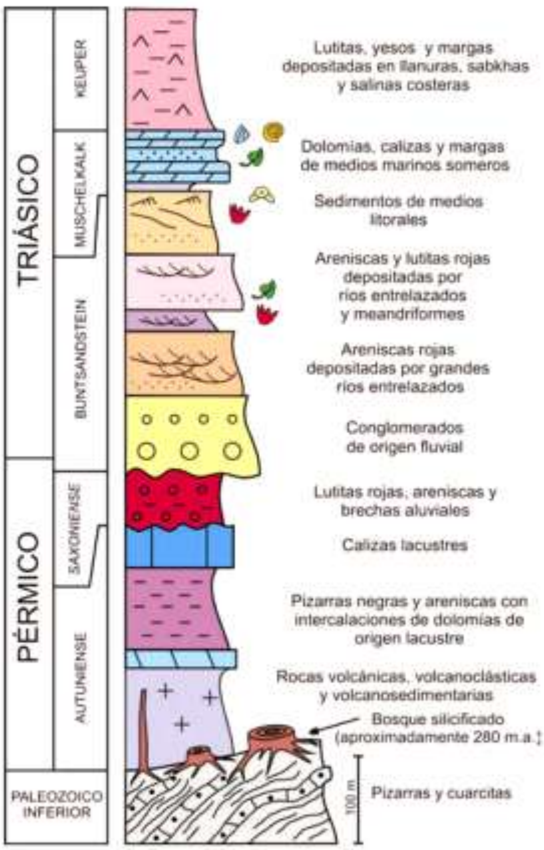

Fig 14. Permo-Triassic estratigrafic column

On top of these former rocks a clear lithologic change can be observed, marked by the apparition of **Capas Dolomíticas Formation**, constituted by dolomites, and "**Capas de Royuela Formation**", formed by an alternance of marls and dolomites. These rocks belong to the **Germanic facies Muschelkalk**.

Sierra de Rueda (Palaeozoic)

Arenas Utrillas (Cretácic)

Cenozoic sediment near Molina de Aragón

The Keuper Germanic Facies is in sedimentary continuity with the unit "Capas de Royuela". In the vicinity of the town of Molina de Aragón two sequences may be distinguished in the facies Keuper series (Sopeña and Sánchez-Moya, 2008): a lower sequence constituted by grey or black mudstones and gypsum with sandstones and carbonates. It is easy to find in these levels minerals as aragonite, red quartz, and gypsum crystals.

Jurassic

Jurassic rocks in this region are mainly carbonate rocks (limestones and dolomites). These rocks follow structures along NW generated during the compressive stage of the range. Jurassic in the western sector of the province of Guadalajara is practically non-existent due to successive erosion stages which took place later on (Fig. 15). However, in the western sector of the province, where Molina and Alto Tajo County is located, all the Jurassic units are preserved (Gómez y Canales, 2008).

The Jurassic sedimentary sequence in this region (Fig. 16) begins with materials that form **“Renales Group”:**

- The first unit we can find is **“Imón Formation”**, concordant with Keuper facies. This Formation is made up of grey dolomites.
- Over them is **“Cortes de Tajuña Formation”** characterized by the presence of breccias, usually covered. The limit between Upper Triassic and Lowe Jurassic is usually to be found on the upper stretch of this unit.
- Upon these rocks there is a carbonate unit, **“Cuevas Labradas Formation”,** made up of a lower level composed of limestones and dolomites, and an upper one with limestones and dolomites.

Fig 15. Map of the Jurassic outcrops of Molina Alto Tajo area (Gomez y Canales 2008)

After this materials, appears the “**Ablanquejo Group**” with this units:
- **“Cerro del Pez Formation”** is arranged over an ironed surface, whisch acts as a limit to the former “Cuevas Labradas Formation”. It is mainly comprised of grey marls.
- The next unit is “**Barahona Formation**”, is made up by bioclastic limestones. The upper limit of this formation is defined by an ironed surface.
- “**Turmiel Formation”**, constituted by alternating, sometimes following a rhythmic pattern of marls and limestones can be distinguished (Goy *et al*., 1999).

The next materials form the “**Chelva Group**” and are:
- On top of the previous unit a calcareous section constitutes la “**Chelva Formation”**. This cartographic unit presents a greater surface near El Pobo de Dueñas and it has been feasible to complete a complete section with of 11 units, mainly constited by por limestones and dolomites. This unit represents “**Sot de Chera Formación”**, upon which the “**Loriguilla formation”** is arranged, comprising a rhymical alternation between limestones and marls. On top of these rocks “**Higueruelas formation”** means the end of the Jurassic levels of the region.

Fig. 16 Jurassic Stratigraphic column

Cretaceous

Cretaceous in Molina and Alto Tajo is located along SW and NE of the region. Its mainly a carbonate sequence, a great section of the rocks succession that make up the Cretacic in the region, is near the municipalities of Villanueva de Alcorón and Villar de Cobeta (Giménez y Rey, 1982).
- The first Cretaceous rocks that appear in the area, are limestones, marls, limestone conglomerates and Weald facies sandstones known as “**Huérguina Formation**”.
- On top of these rocks and unconformally is “**Arenas de Utrillas facies Formation**”, mainly formed by sands, clays, sandstones and microconglomerates. Tha lay over the precedent formation or over Jurassic units.
- A gradual transition is to be found in “**Nuévalos formation”**, characterized by a rich lithological variety mainly formed by limestones and dolomites and marls all of them clearly stratified. In the same way as in the previous case, the transit between this formation and the preceding one (Monterde formation) is gradual. This unit is formed by limestones and marls, with the presence of limestones.
- The upper limit bordering with the next unit, the “**Ciudad Encantada Formation**” sometimes might become erosive. This cartographical unit is quite homogeneous formed by dolomites and limestones.

Limestones of “Ciudad encantada Formation” in Peñalén

- Upon this dolomitic and limeston formation, “**dolomías y calizas dolomíticas estratificadas del embalse de la Tranquera Formation”** appear. Within this unit we can distinguish levels of dolomite and dolomite breccias.

- The last unit of the Cretacic in this area is the “**Brechas Dolomíticas de Cuenca” Formation** This unit has a gradual limit with the previous unit, which, as previously mentioned, has a dolomitic breccia level at top. This formation does not appear throughout the whole region, because being the last Cretaceous unit, it may be totally or partially eroded or covered by tertiary rocks (Giménez y Rey, 1982). .

Cenozoic

Some authors (Olmedo et al., 2008) has distinguish four units in this region. The first unit has, at times, a gradual boundary with the latest materials Cretaceous. It consists of a series of levels, calcareous or clay with sandy intercalations casts.

- This unit is **Villalba de la Sierra Formation**, which outcrops in Cuenca´s Range and the Altamira´s Range areas.

- The next unit, known as **Unit T1 or pretectonic** series is presented on the previous jarring and comprises very cemented conglomerate, sandstones and clays, marly sections presenting to top. Later, discordant over the former appears

- The **Unit T2 or Series Syntectonic** is characterized by the presence of quartzitic or calcareous gravel or sandstones and red clays, presenting to top calcareous sandy limestone, limestone and marl.

- Finally there´s a **Unit T3, or Series Postectonic Series**, which forms the filling Tajo Basin and small intramontane basins that can be recognized in this region. .

Tectonics
The Iberian Range is the result of a succession of several tectonic events (Garcia Quintana, 2008):

- Process sedimentary in the Lower Palaeozoic. .
- Compressive Process in Middle and Upper Palaeozoic. .
- Process of rifting during Mesozoic with several pulses of stretching and extension of the Iberian plate crust and subsequent thinning. .
- Process shortening and compression during the Cenozoic, and consequent thickening.

During the extensive phase of the crust and generated a depressed area which was successively stretched completely filling of sediments, while during the compressive stage, these sediments were folded, faulted and uplifted. Palaeozoic materials located below Mesozoic deposits show signs of folding, breakage and in some cases metamorphism, all as a result of the Variscan Orogeny. These same materials assimilate efforts produced during the Alpine Orogeny generating faults and deformation of large magnitude, becoming the Zocalo Varisco or Hercynian of the Iberian Range. The vertical displacement of some of the fractures present in the materials of Palaeozoic allows them to come to surface in some parts of the region as Aragoncillo or Checa area. .

Geomorphology

But most of all, the variety of geomorfological features which furnish this area with a wide range of different landscapes and as we explain below, an outstanding interest as regards to divulgation-interpretation. Apart from the fluviokarstic canyon of the river Tagus after which the territory is named, we could highlight other canyons carving over sandstones and Buntsandstein conglomerates by rivers as the Arandilla and Gallo. Furthermore, there are plentiful karstic manifestations as it is the case with caves, sinkholes, poljes, springs and tuffs (some of which are currently still active). There could also be added waterfalls and lakes, and several periglaciar features as block fields or block streams. The existence of prominent tectonic features and folds create a structural landscape with deep river incisions.

B.2.3. Geological History

Palaeozoic

The geologic history of the region dates back to 450 million years, where massive marine platforms begun to develop surrounding Gondwana. During this very first stage, The area we are dealing with and, in general, the whole Iberian Peninsula was located in latitudes very close to the South Pole, where major glaciomarine sedimentation took place, a great deal enhanced by a strong glaciations at the end of the Ordovician period, whose consequences deeply affected the weather and the existing organisms of that age which lasted approximately 20 million years. At that time, the sedimentary basin mainly behaved as a passive margin and was altered by extensional tectonics which caused normal faults and gravitational slides. Gondwana´s surface was fraught with glaciers that, sometimes, released huge icebergs that reached the ocean. Some of these icebergs held rock fragments dragged by the erosive effect of the glaciers. These dropstones got to get released from the icebergs as a consequence of their thawing in warmer places. A good example of these phenomena is to be found in Checa.

Later on, at the beginning of Silurian, Gondwana´s continent began to drift towards the North, which caused the region we are dealing with to move towards lower latitudes. These conditions make themselves evident by carbonated sedimentation, as befits subtropical from the lower Devonian on. Slowly, Gondwana´s continent collided with the macrocontinente Laurusia (formed by the previous unification, during the Caledonic orogeny, of the continents Laurentia, Avalonia and Baltica), during Carboniferous (Variscan orogeny). This collision´s result was the formation of the Pangea.

During the Permian, the supercontinent Pangea migrated towards the North causing the equatorial line to go through the current province of Guadalajara. At that age the climate was even warmer and more arid than at previous ages. This caused shores to withdraw and the sea level to dwindle globally, causing the formation of a great amount of evaporites about many epicontinental areas.

Mesozoic

During the late Permian and early Triassic began early extensional movements that would result in the subsequent fragmentation of Pangea and the westward advance of the Tethys Sea. Were generated also broad valleys of ancient faults of NW-SE, with a major river system. The process of widespread rifting and subsidence therefore favoured the accumulation of powerful series of alluvial conglomerates, sandstones and shales of currently constitute some of the most spectacular scenery and famous in the province of Guadalajara (Hoz del Río Gallo, Sierra de Caldereros, etc.). During this period, the evolution vertical drainage networks was largely controlled by regional tectonics and climate (continental and arid). During the Middle Triassic began Tethys advancing the west. In the sedimentary record can recognize two separate transgresive episodes one regressive. The first transgresive episode reached the eastern end of the province of Guadalajara (Molina ands Alto Tajo of). This first transgression can be recognized in some Triassic outcrops at the east Molina de Aragon, characterized by the presence of small levels of carbonates and evaporites above Buntsandstein red series. The second transgression, which affected the entire province, is recognized by the presence of carbonate lithologies (limestones and marls) with some shaly intercalations. These materials, belonging to the Germanic Muschelkalk facies correspond to a complex of shallow marine carbonate with development and supratidal tidal flats, lagoon and inner shelf. A late Middle Triassic, Iberian Massif reliefs is softened following the continuous supply sediment into rivers draining into the Tethys. Also during this time began a further decline in sea level and generated large evaporite deposits in an extensive coastal plain regressive state. These facies, composed by shales with abundant gypsum and some interbedded dolomite are the German Keuper facies. Sediment with salts, which have generated valuable since medieval holdings in the Shire of Molina. Within the study area, specifically around the town of Molina de Aragón, there are two sequences in vertical succession Keuper facies, consisting of a lower casts dark shales with interbedded sandstones and carbonates, and an upper, generated in an environment of sebkhas or marshes in wet weather, composed by red shale interbedded with anhydrite and carbonates. Early Jurassic, Guadalajara was located under latitude of about 35 ° N, with a slightly warmer and drier climate than today. The installation of marine environments during the Jurassic in the province of Guadalajara took place in a series of transgresive-regressive pulses. The beginning of the Jurassic in this region is characterized by a transgresive episode that.

Cenozoic

Over the Tertiary extensional dynamics ends and passed to a compressive regime with the first movements corresponding to the Alpine Orogeny, which resulted in the final withdrawal of the sea level. From the lower and middle Eocene, as a result of tectonic movements produced basins begin to experience a progressive accumulation of coarse detritic material. In the final stages of these river silting palustric basins, evidenced by the appearance of sections of limestone with algae. Subsequently, a process of generating folding in the Oligocene, for Phase *Castellana of Alpine Orogeny*, which led to the razing of the raised areas, preserving the rest in small trays. During the mid-upper Miocene and Pliocene basins were greater entity, where detritic sedimentation continued contributions of materials with different grain size. These contributions culminated with a system of wide plateau lake. .

From the late Pliocene and Quaternary began the installation of the current river network, and its engagement sedimentary progressive series described above. This is marked by the presence of numerous river terraces and numerous erosion surfaces filled by morphology glacis deposits. These deposits, belonging to the early stages of the Quaternary sedimentation are subsequently dissected by an incipient network river which is currently under development.

Buntsandstein facies in River Gallo canyon

B3. Listing and description of geological sites within the proposed Geopark

The next table shows the main geologic interest items of Molina an alto Tajo as well its characteristics and protection status (see fig. 17 for location).

Nº	NAME	MAIN INTEREST	MAIN USE	DEGREE OF PROTECTION	DIVULGATION FACILITY
G1	Río Tajuña cliffs	Geomorfology	Turistic-Didactic	NIL	NIL
G2	Tufa limestone	Geomorfology	Turistic-Didactic	NIL	NIL
G3	Paleozoic-Mesozoic Discordance at Los Milagros Valley	Stratigraphy	Educational	Natural Park	YES Itinerary+panel
G4	Los Milagros valley and rock towers	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel
G5	Los Casares Cave	Paleonthologic	Turistic Scientific	Natural Park	YES Itinerary+panel Guided visits
G6	Saelices de la Sal salt Works	Stratigraphy Cultural	Turistic-Didactic	Natural Park	YES Itinerary+panel
G7	Tajo canyon	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel
G8	Los Cuchillares	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+plate
G9	Hundido de Armallones	Tectonics Geomorphologic	Turistic-Didactic	Natural Park	YES Itinerary+panel
G10	Las Cárquimas waterfall	Geomorphology	Educational	Natural Park	NIL
G11	la Inesperada salt works	Stratigraphy Cultural	Educational	Natural Park	NIL
G12	Aragonitos and jacintos de Cobeta´s Outcrop	Mineralógico	Turistic-Didactic Educational	Natural Park	YES Itinerary+plate
G13	Geological resources	Cultural	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G14	Arandilla river canyon	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G15	Arandilla hanging valley	Geomorphology	Scientific	Natural Park	YES Itinerary+plate
G16	Alcorón cave	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G17	Claro limestone pavement	Geomorphology	Scientific	Natural Park	NIL
G18	Hoya del Espino limestone pavement	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G19	Utrillas Sandstone old pit	Stratigraphy	Scientific	Natural Park	YES Itinerary+panel+plate
G20	Poveda thrust fault	Tectonics	Scientific	Natural Park	NIL
G21	Arroyo de la Hozn faults and folds	Tectonics	Scientific	Natural Park	NIL
G22	Tajo old meander	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G23	Taravilla lagoon	Geomorphology Sedimentológico	Scientific Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G24	Poveda waterfall	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary +plate
G25	Tajo Canyon (Herrería Bridge- Hundido de Armallones section)	Geomorphology	Turistic-Didactic	Natural Park	NIL
G26	Horcajo Cliff	Geomorphology	Turistic-Didactic	Natural Park	NIL
G27	Chequilla sorroundings	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary +plate
G28	Chequilla monolith	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G29	Graphtolite bed of Checa	Paleonthologic	Scientific Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G30	Checa´s *Dropstone*	Stratigraphy	Scientific Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G31	La Aguaspeña tufa waterfall	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel
G32	El Cubillo poljé	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel
G33	Tornero cave	Geomorphology	Turistic-Didactic	Natural Park	NIL
G34	Variscian folds in Checa and Orea	Tectonics	Scientific Educational	Natural Park	YES Itinerary+panel
G35	Siluran section in Checa and Orea	Stratigraphy	Scientific Educational	Natural Park	NIL
G36	Vulcanic site of Alcoroches	Volcanic	Scientific	Natural Park	NIL
G37	Stone river of Sierra de Orea	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel

G38	Vulcanic site of Orea	Volcanic	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G39	La Salobreja lagoon	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+plate
G40	Peat bogs	Geomorphology	Turistic-Didactic Educational	Natural Park	Itinerary+panel
G41	Karstic Spring	Geomorphology	Educational	Natural Park	YES Itinerary+plate
G42	La Escaleruela tufa waterfall	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G43	El Campillo tufa building	Geomorphology	Educational	Natural Park	NO
G44	San Pedro´s bridge tufa building	Geomorphology	Turistic-Didactic	Natural Park	NO
G45	la Fm. Barahona paleontologic site	Paleonthologic	Turistic-Didactic	Natural Park	YES Itinerary+panel
G46	Folds in Cuevas Labradas limestones Formation	Tectonics	Turistic-Didactic	Natural Park	YES Itinerary+panel+plate
G47	Fm. Cuevas Labradas Stratotype	Stratigraphy	Educational Scientific	Natural Park	YES Itinerary+panel
G48	Muschelkalk facies with salt pseudomorphs	Stratigraphy	Educational Scientific	Natural Park	YES Itinerary+panel
G49	Permo-Triassic section in Barranco de la Hoz (Barranco de la Hoz Canyon)	Stratigraphy Geomorphology	Educational Scientific	Natural Park	YES Itinerary+panel+plate
G50	Aragonite type-locallity	Mineralógico	Scientific Educational	NIL	NIL
G51	River Mesa gorge (I)	Geomorphology	Turistic-Didactic	In proccess LIC+ZEPA	NIL
G52	River Mesa gorge (II)	Geomorphology	Turistic-Didactic	In proccess LIC+ZEPA	NIL
G53	Mesa (isolated hill)	Geomorphology	Turistic-Didactic	NIL	NIL
G54	Sierra de Aragoncillo petrified forest	Stratigraphy Paleonthology	Scientific	NIL	NIL
G55	Permian-Triassic section at Rillo de Gallo	Stratigraphy	Scientific	NIL	NIL
G56	Fuentelsaz stratotype (GSSP)	Stratigraphy Paleontoló	Scientific	NIL	NIL
G57	Caldereros´hills	Geomorphology Stratigraphy	Turistic-Didactic Scientific	Natural Monument	YES Brochure
G58	Mines of Setiles	Mineralógico- Minero	Scientific	NIL	NIL
G59	Museum of Molina de Aragón	Paleonthology Cultural	Turistic-Didactic Scientific	SI	YES Several panels and brochures
G60	Estrella Mine (Copper)	Mineralogic-Minero	Scientific	NIL	NIL
G61	Poveda de la Sierra and Peñalén mines	-Ambiental Geomorphology	Scientific Educational	NIL	NIL
G62	Armallá salt Works	Stratigraphy Cultural	Turistic-Didactic	NIL	NIL
G63	Alustante limestone pavement	Geomorphology	Scientific	LIC+ZEPA	NIL
G64	Peñas Rubias	Geomorphology	Turistic-Didactic	Natural Park	YES Itinerary+ plate

Fold in Jurassic limestones in his type section of Cuevas Labradas

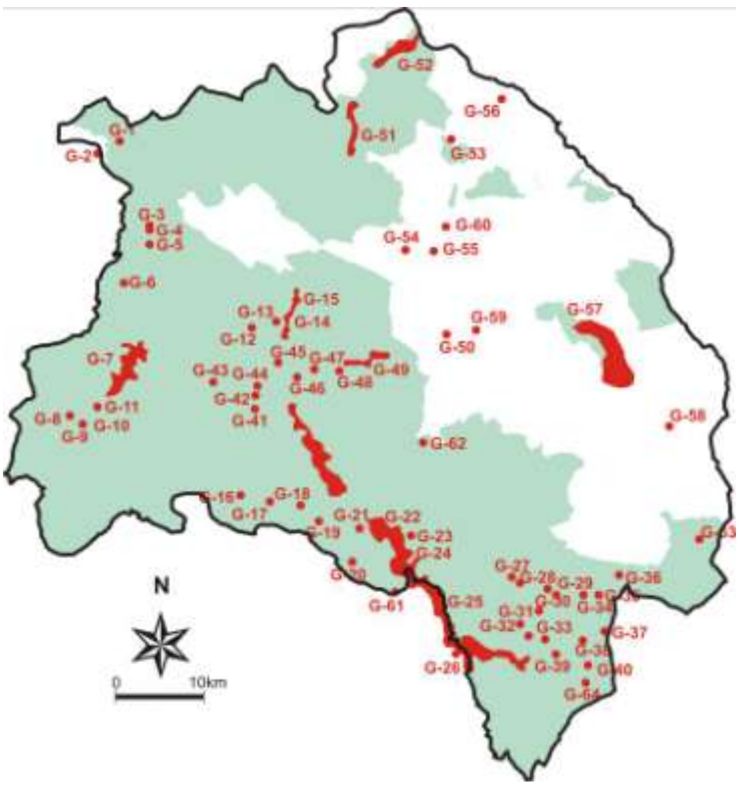

Fig.17. Map of the Geosites in the Comarca of Molina and the Alto Tajo.

B.4. Details on the interest of these sites in terms of their international, national, regional or local value

These sites were selected and evaluated in various inventories:

- Preliminary inventory for the realization of the Plan of Arrangement of the Alto Tajo Natural Park Resources (1999): to delimit the perimeter of the Natural Park, an inventory of 125 sites of geological interest identified and assessed for that remain enshrined in and protected perimeter to Natural Park management attend to his nature.

- Inventory for the realization of the Geo-routes: 80 locations were identified where to focus outreach efforts this project, all equipped with displays and / or ceramic plates, and brochures and a specific description each place in Geological Guide Alto Tajo Natural Park.

- Geosites Global Inventory Project 2000-2007: the national inventory, in which more than 70 specialists geological disciplines, identified 20 contexts (frameworks) international geological significance in Spain, four of which are represented in the territory of the Region de Molina: Series sedimentary and metamorphic Stratotypes Palaeozoic and Mesozoic Iberian Chain Bética. Subsequently identified 144 Spanish Geosites constituting the Spanish contribution to global geological heritage. Four of them are included in the territory of the Geopark: 1-stratotype Fuentelsaz; 2 - stratotype of the Barranco de la Hoz, 3- Graptolites outcrop in Checa, 4-Dropstone and Lower Silurian section of Checa.

- Study of valuation and potential use of different geological attractions in Molina and Alto Tajo included in the Diploma Advanced Studies (DEA) conducted by D. Alberto Lebron and directed by Amelia Calonge (University of Alcalá de Henares) and Luis Carcavilla (IGME).

- Letter Geological of Molina: sponsored by the Museum of Molina, seeks to identify the geological outcrops and paleontological sites that have been investigated by any research group and make a tab for the systematic data collection.

Within this area we may find geological elements truly noteworthy, some of which can be deemed scientific references worldwide. But aside from this rich geological heritage, the huge geological diversity might be from a geological point of view the factor that renders such singularity to this territory. Diversity is the most used term for describing the biotic values and the geological characteristics. As regards the geodiversity and geological heritage of the Molina and Alto Tajo we should highlight the presence of outstanding series from Silurian, Ordovician, Triassic, Jurassic and Upper Cretaceous. The ones from the Lower Silurian among the most important, being a bioestratigrafic reference worldwide; Lower Triassic Series are included in the Spanish list of the project *Global Geosites*; and the Toarcian-Aalenian section in Fuentelsaz, until lately the sole *Global Boundary Stratotype Section and Point* (GSSP) in Spain passed by International Commission on Stratigraphy od the International Union of Geological Sciences (IUGS;http://www.stratigraphy.org/aalenian.htm). The lithological diversity is remarkable as well, with powerful outcrops of shales, quartzites, sandstones, limestones, dolomites, sands, salt deposits, gypsum and volcanic rocks (dacites). The presence of rich levels of minerals as Compostela red quartz (red coloured ferruginous quartz) and aragonites is another outstanding feature, which is precisely named after the Comarca de Molina de Aragón, whence the very first described units were found.

There are also rich fossil levels, among them one of the most important deposits in the Peninsula graptolites, we should add other plentiful Mesozoic outcrops.

Besides, there is an inventary derived from PORN in which 70 geomorphological sites in the Natural Park were identified where Geoconservation focus and efforts should be enhanced, in which no spreading initiatives nor public usage have been carried out so far (due to its difficult access and other inconveniences). But whose protection is nevertheless mandatory by law. These places are described, assessed and placed in a research backed up by the Natural Park (Fig.18). As a result of the analysis of these enclaves, the First Inventary of Geosites in the Geopark will be completed, currently amounting to 64 places.

Variscan folds in Checa (south of Molina and alto Tajo territory)

“Aguja de la Gitana” River Tagus Canyon

“Los Milagros”, Molina and alto Tajo

Permic silicified basement tree fron “Sierra de Aragoncillo” Molina and Alto Tajo

“La Escaleruela” Travertinic building and fall, River Tagus Canyon, Molina and Alto Tajo.

Lower Triassic reptile footsteps from Rillo de Gallo, Molina and Alto Tajo.