FIELDTRIP GUIDEBOOK

THIRD INTERNATIONAL BIOEROSION WORKSHOP
BARCELONA 2000

SHALLOW MARINE MACROBIOEROSION

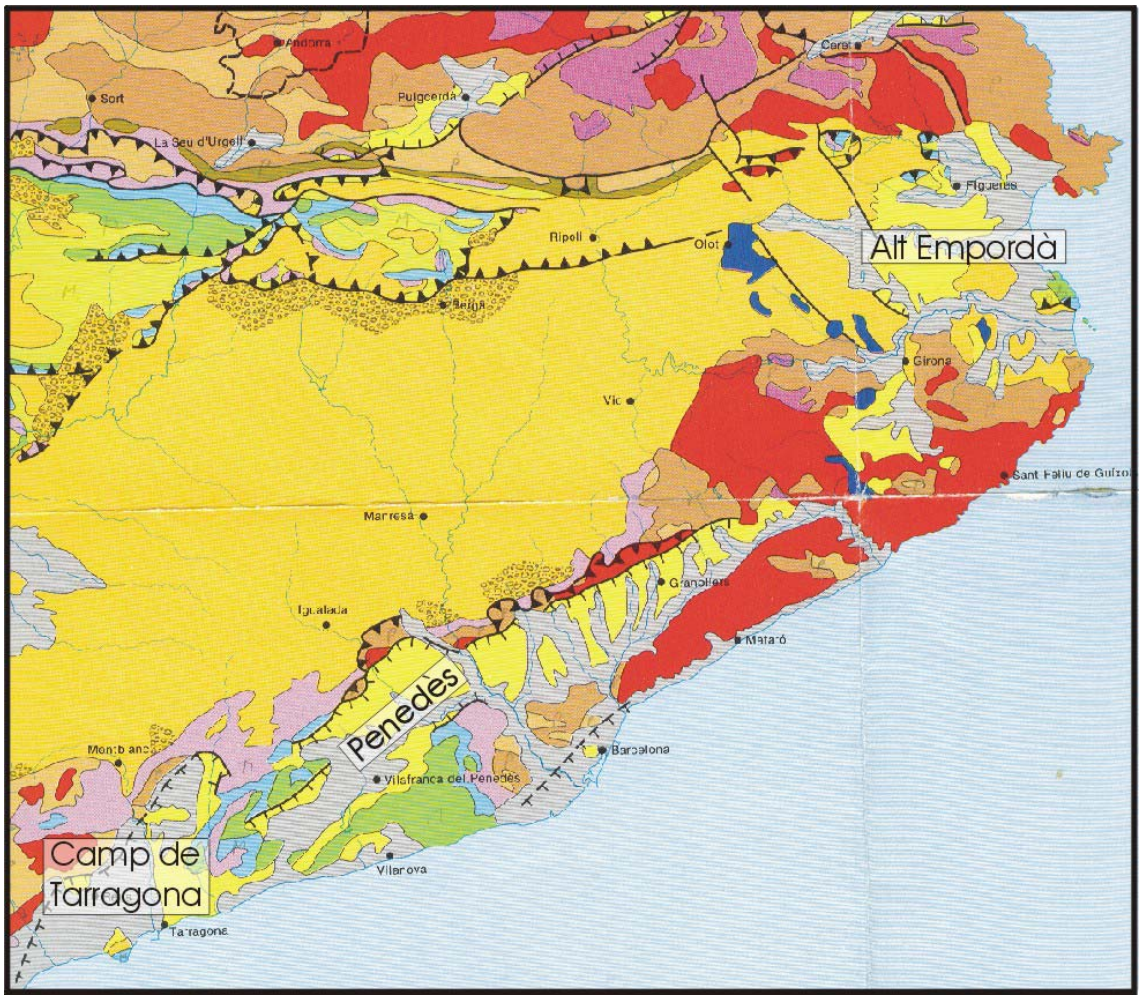
IN THE NEOGENE OF CATALONIA

Excursion leaders: Jordi MARTINELL, Rosa DOMÈNECH and Jordi M. de GIBERT

FOREWORD

The marine Neogene is well represented in Catalonia and it has been well known and studied for more than a century. The marine Miocene is represented in the Penedès and Camp de Tarragona Basins, while the marine Pliocene occurs in the Alt Empordà, Baix Llobregat and Baix Ebre basins. The objective of the fieldtrips is to visit several localities in three of those basins (Penedès, Camp de Tarragona and Alt Empordà) which are of special interest for bioerosion specialists. Most of the localities that will be visited correspond to ancient rocky shores, but also bioerosion in reefs and shelly substrates will be observed. The ichological content of all these Neogene localities is characterized by a *Gastrochaenolites-Entobia* assemblage which corresponds to the *Entobia* ichnofacies of Bromley and Asgaard (1993). This ichnofacies is typical for nearshore environments since the Jurassic.

The fieldtrips will be completed with some non-ichnological stops devoted to visit certain points of historical interest.



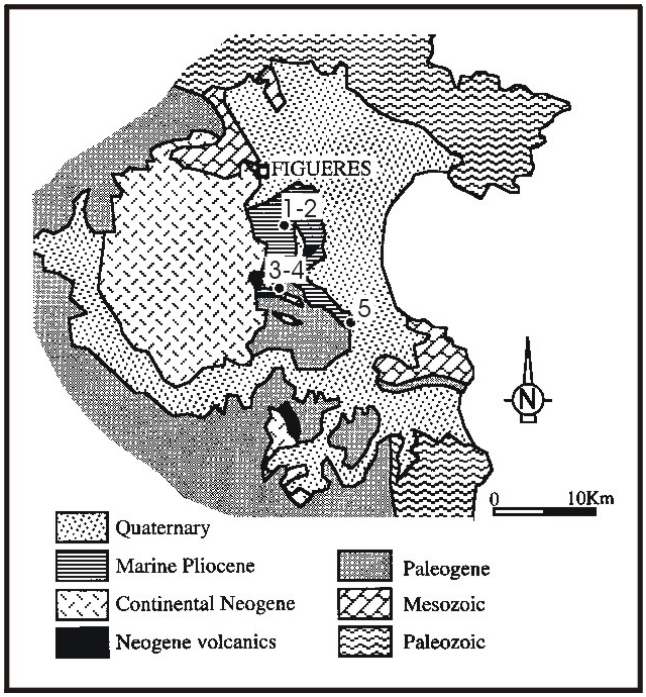
FIELDTRIP 1: MACROBIOEROSION IN THE ALT EMPORDÀ BASIN

August 29, 2000

INTRODUCTION

The Alt Empordà Basin is located in the Girona province (NE Spain). The basin is a relatively flat area bounded to the North by the Pyrennees, to the south by the Montgrí and Les Gavarres and to the East by the Mediterranean Sea.

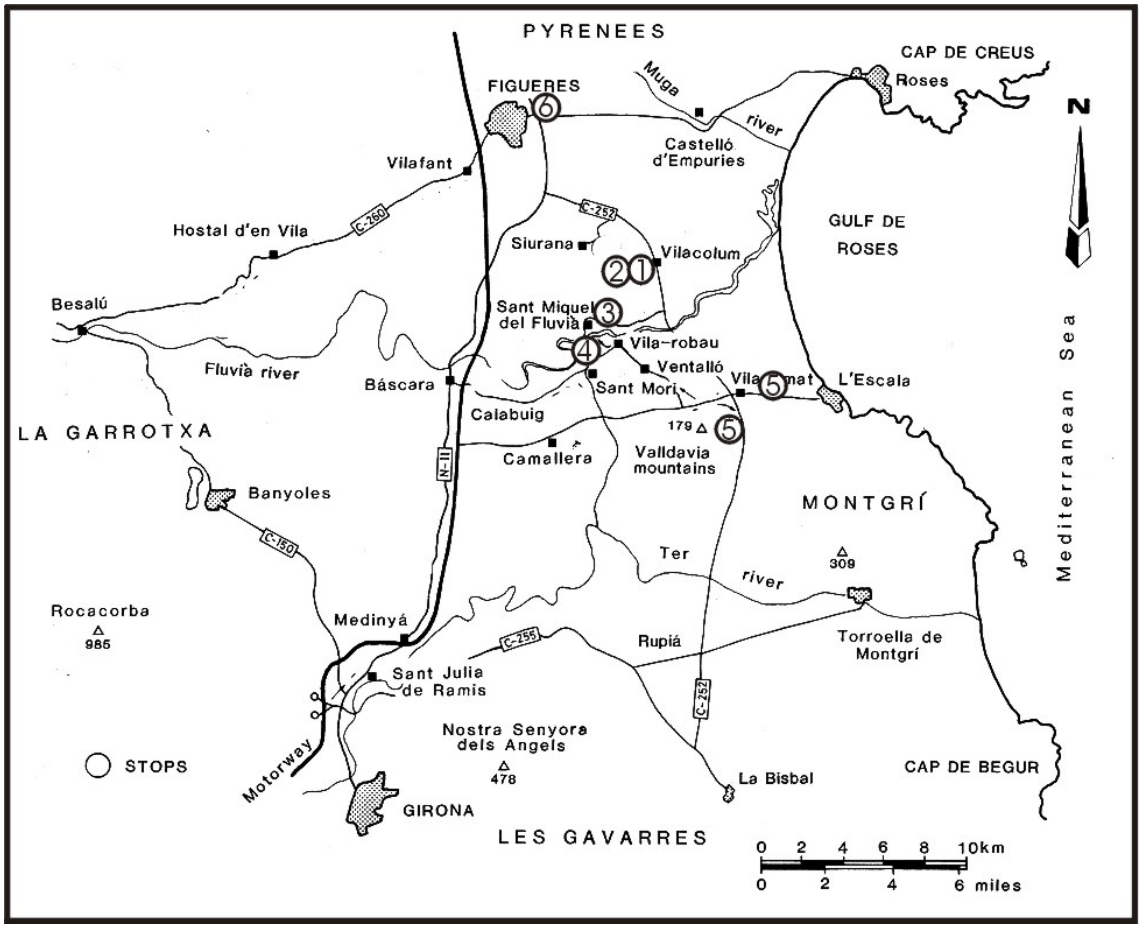
The Alt Empordà Basin (see map on the right) is a horst filled by Miocene and Pliocene continental and marine deposits. The Neogene materials lay upon Paleozoic, Mesozoic and Paleogene rocks. The observations of the fieldtrip will be focused on Pliocene bioerosion. The Pliocene sequence (Zanclean) unconformably overlies the Miocene deposits. The Pliocene marine record includes paleocliffs, fan delta conglomeratic deposits and sandy and muddy bay sediments.



DESCRIPTION OF THE STOPS

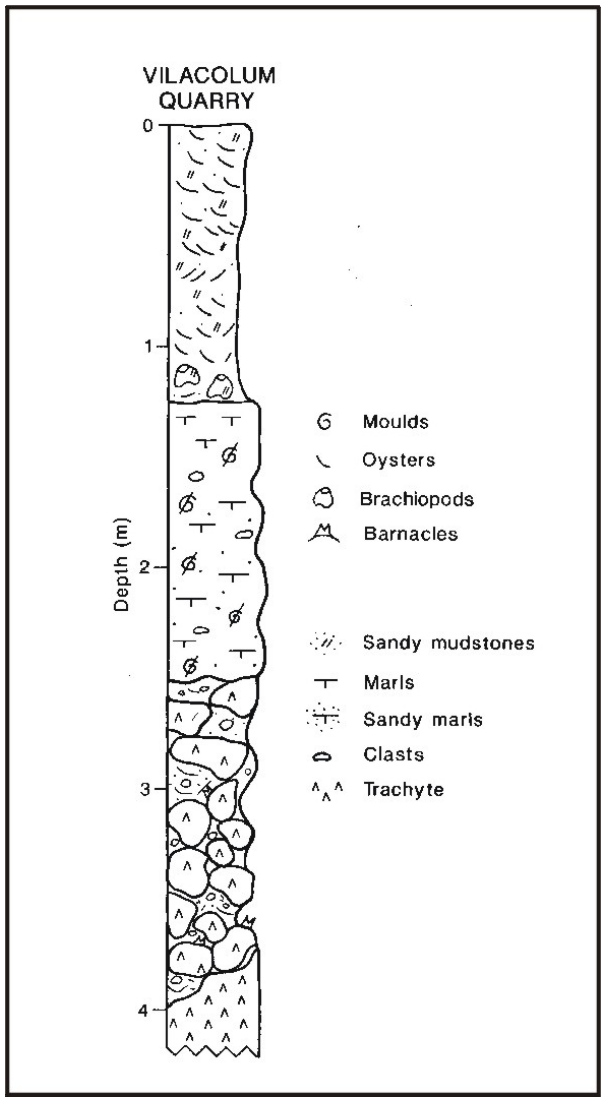
Six stops will be visited during the day (see map below).

Four of the stops will be to observe bioerosion on Pliocene rocky shores developed upon diferent substrates (volcanic rocks, limestones, conglomerates) and bioerosion on the shells occurring in the associated deposits. The two other stops will consiste of the visit to two historical sites.



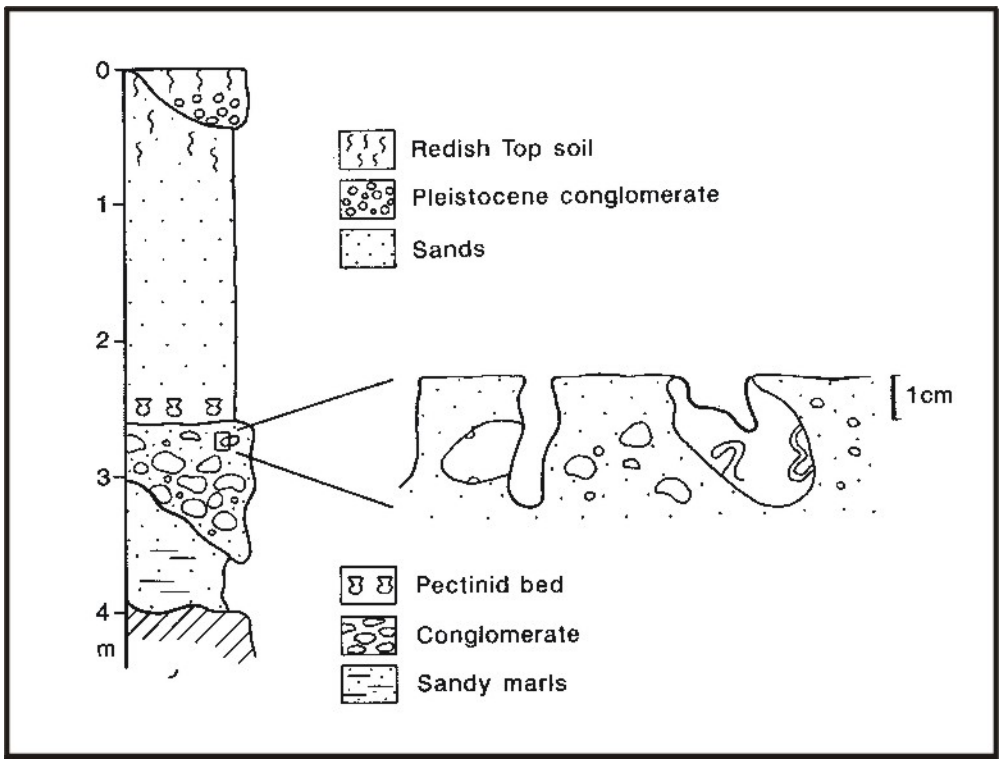
STOP 1. VILACOLUM

The Vilacolum outcrop consists of Miocene volcanic materials (trachyte) covered by Pliocene sediments. Three units can be distinguished within the Pliocene section. The lower unit consists of heterometric conglomerates whose clasts host epilithic fauna, particularly barnacles (*Balanus concavus, B. Trigonius*). The middle unit is constituted by sandy mudstone with abundant moulds of bivalves and gastropods. The upper unit is the most fossiliferous. It is constituted by fine sands with brachiopods (*Megathyris detruncata, Mergelia truncata, Terebratula terebratula*), oysters (*Ostrea lamellosa*) and bryozoans (*Crisia* sp., *Filisparsa* sp.). Bioerosive activity is very well represented, particularly on oyster shells. Several ichnotaxa have been recognized: *Gnatichnus pentax, Podichnus centrifugalis, Oichnus simplex, Entobia* isp., *Caulostrepsis* isp. and *Maeandropolydora* isp.



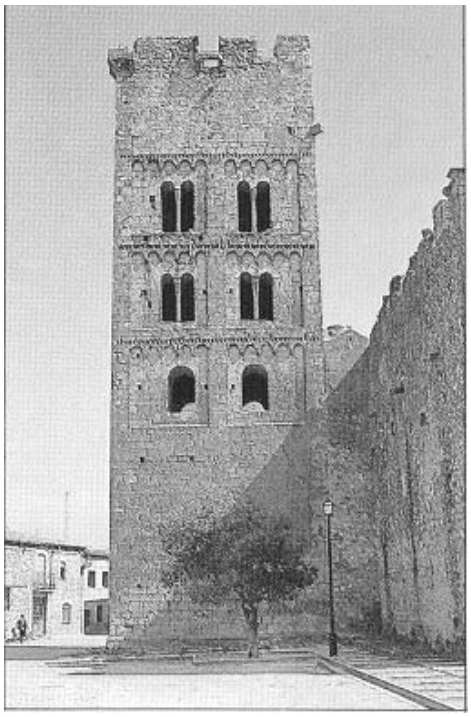
STOP 2. ELS OLIVETS

This section is constituted by 4 meters of yellow sands with and interbedded decimetric (30-70 cm) conglomeratic layer. These pliocene materials overlie Eocene calcarenites. The paleorelief surface shows abundant *Gastrochaenolites* and some possible *Circolites*. Bioerosive traces are even more abundant in the conglomeratic bed where they penetrate not only the clasts and encrusting shells (the pectinid *Hinnites ercolanianus, Ostrea lamellosa* and barnacles) but the matrix too. This fact points out the existence of two phases of bioerosion: one taking place over the unconsolidated gravels and a second one occurring after cementation. The first suite includes *Gastrochaenolites, Entobia, Maeandropolydora, Caulostrepsis, Trypanites* and *Iramena*; the second one consists mostly of larger *Gastrochaenolites* and *Entobia*. The sands contain abundant pectinids (*Chlamys seniensis, Ch. Latissima*), oysters (*Ostrea lamellosa*) and some brachiopods (*Terebratula terebratula*) which also host bioerosion estructures (*Centrichnus concentricus, Podichnus centrifugalis, Gnatichnus pentax, Oichnus paraboloides*).



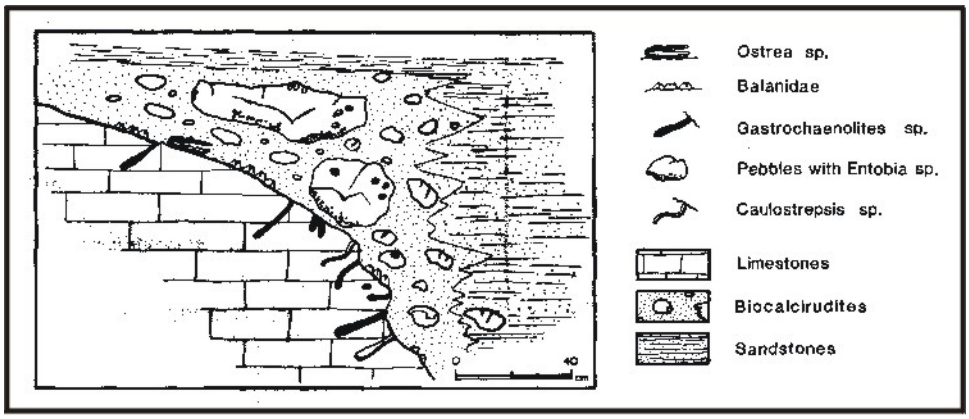
STOP 3. SANT MIQUEL DE FLUVIÀ

The church at Sant Miquel de Fluvià is one of the most interesting examples of the Empordà Romanesque architecture. It was built in the 11th century and later reformed in the 16th century when the Gothic choir and doorway were constructed. The bell tower was erected in the 12th century.



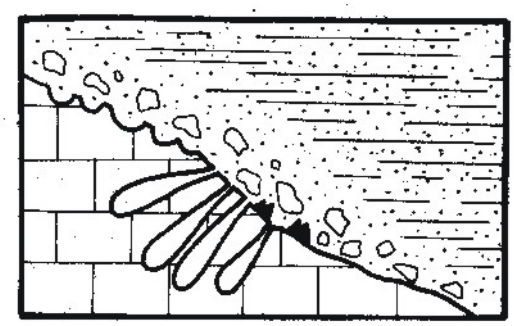
STOP 4. SANT MIQUEL-SANT MORI

At this locality the Pliocene sediments overlie Cretaceous limestones. The unconformity between both is extensively covered by *Gastrochaenolites torpedo* and *G. lapidicus* with densities reaching over 250 borings per square meter. Other borings are also present: *Entobia* isp.*, Caulostrepsis taeniola* and *Maeandropolydora sulcans.* The bored surface also hosts abundant encrusting balanids, oysters and the pectinid bivalve *Hinnites ercolanianus*. Their shells are also bored with idiomorphic *Entobia, M. sulcans* and *C. taeniola.* The overlying Pliocene sediments include limestone boulders and clasts with the same boring assemblage.



STOP 5. VILADAMAT

At Viladamat we will see the section of a gravellous fan delta. The clasts are poorly bored but borings are very abundant in a small adjacent outcrop upon Eocene limestones. The peculiarity of this paleorocky shore site is that it is possible to recognize a three-stage vertical zonation of the borings. From top to bottom we can distinguish three different levels constituted by *Circolites kotoncensis, Gastrochaenolites and Entobia*, respectively. The preservation of the three levels is an indication of a temporary cessation in the rise of sea level.



STOP 6. CASTELL DE SAN FERRAN

The San Ferran Castle, in Figueres, is the largest European fortress of the 18th century and the largest monument in Catalonia with a total area of 320.000 m^2. It took 13 years (1753-1766) and the daily work of more than a thousand workers to accomplish the construction of the fortress.

FIELDTRIP 2: MACROBIOEROSION IN THE CAMP DE TARRAGONA AND PENEDÈS BASINS

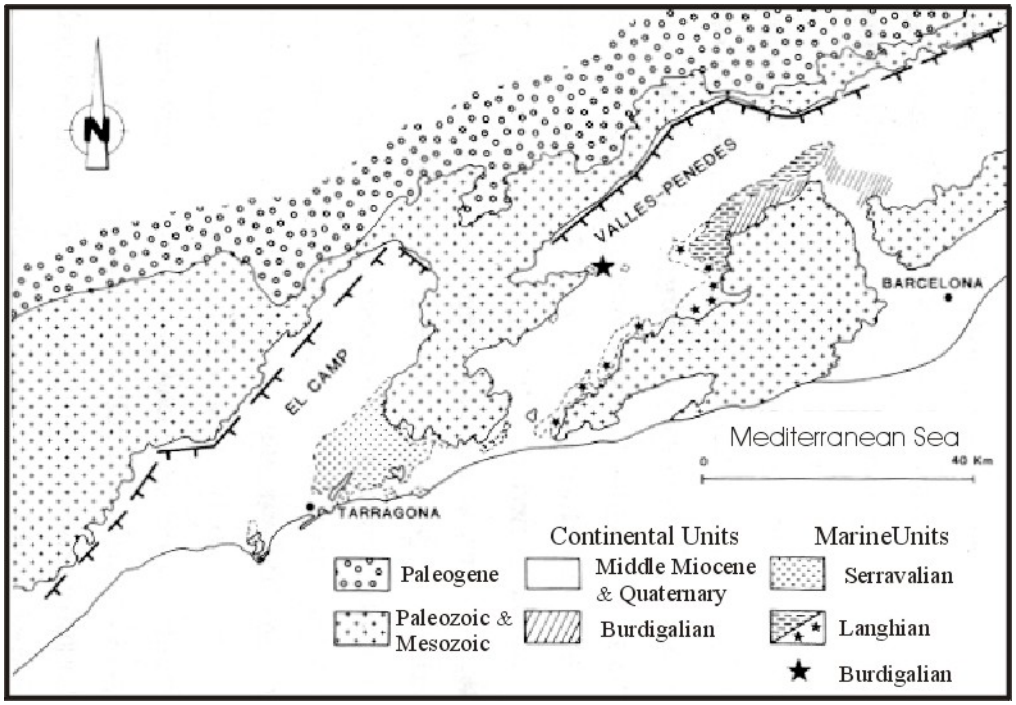
August 31, 2000

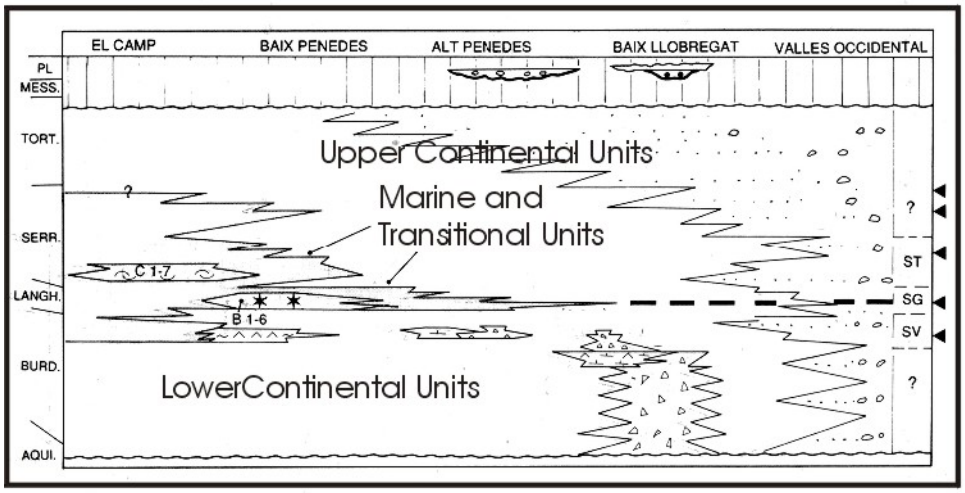
INTRODUCTION

The Camp de Tarragona (located in the surroundings of Tarragona) and the Penedès basins (in the surroundings of Villafranca del penedès) are two half-grabens oriented parallel to the present Mediterranean coast included within the Catalan Coastal Range. The sedimentary filling of this basins includes Neogene (mostly Miocene) continental and marine deposits. The marine units correspond mainly to two transgressions in the Langhian and the Early Serravalian (Middle Miocene). Somewhat minor transgressions took place in the Burdigalian and Middle Serravalian.

The Langhian transgression is better represented in the Penedès basin. The Langhian marine units consist of terrigenous bay-plattform facies prograding from the active (northwestern) boundary of the basin and carbonate plattform facies developed on the passive (southeastern) boundary.

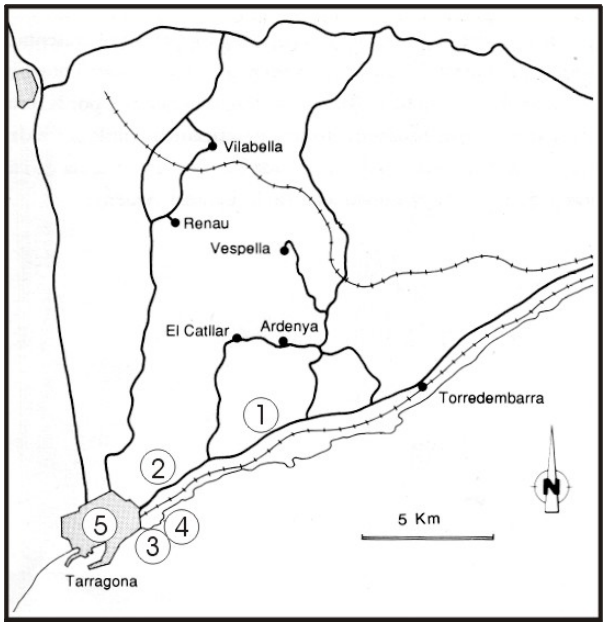
The Serravalian transgression is better represented in the Camp de Tarragona Basin. The deposits related with this transgression correspond to a diverse arrange of facies corresponding to a mixed carbonate-siliciclastic plattform.

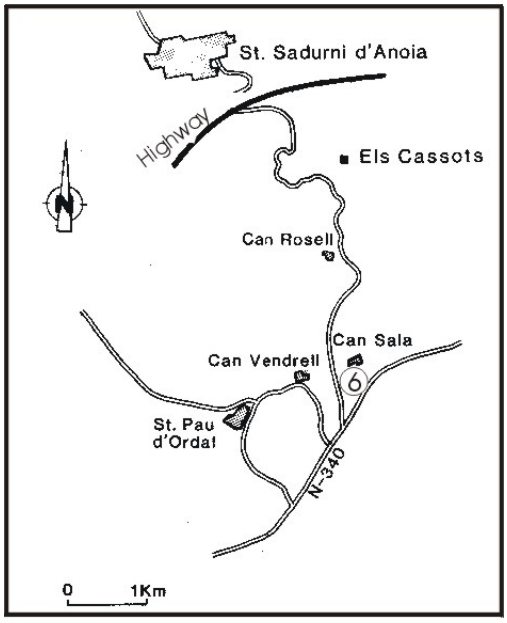

N
VALLES-PENEDES
BARCELONA
EL CAMP
Mediterranean Sea
0
40 Km
TARRAGONA
Continental Units
MarineUnits
Paleogene
Middle Miocene & Quaternary
Serravalian
Paleozoic & Mesozoic
Burdigalian
Langhian
Burdigalian


EL CAMP
BAIX PENEDES
ALT PENEDES
BAIX LLOBREGAT
VALLES OCCIDENTAL
PL
MESS.
TORT.
SERR.
LANGH.
BURD.
AQUI.
Upper Continental Units
Marine and
Transitional Units
C 1-7
B 1-6
LowerContinental Units
?
ST
SG
SV
?

DESCRIPTION OF THE STOPS

The fieldtrip will start with the visit to an ancient Roman quarry excavated on marine Miocene calcarenites. Stops two and three correspond to outcrops of paleorocky shores in the Camp de Tarragona Basin. Stop four is a visit to Tarragona, the ancient Roman capital. Stop five is the visit to a Langhian reef in the Penedès Basin.

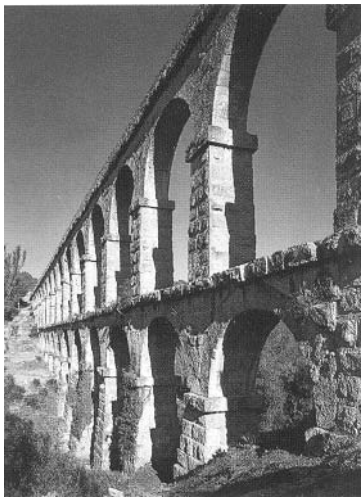




STOP 1. EL MÈDOL

El Mèdol is an ancient quarry excavated by the Romans on Serravalian calcarenites. The quarry is more than 200 m long and 50 m wide. In the center of it, the Roman quarriers left a 16 m high rock column, as an indicator of the amount of rock excavated. The total volume of quarried rock is estimated in 50.000 m^3. The marks left in the stone help to reconstruct the excavation techniques of the Romans.

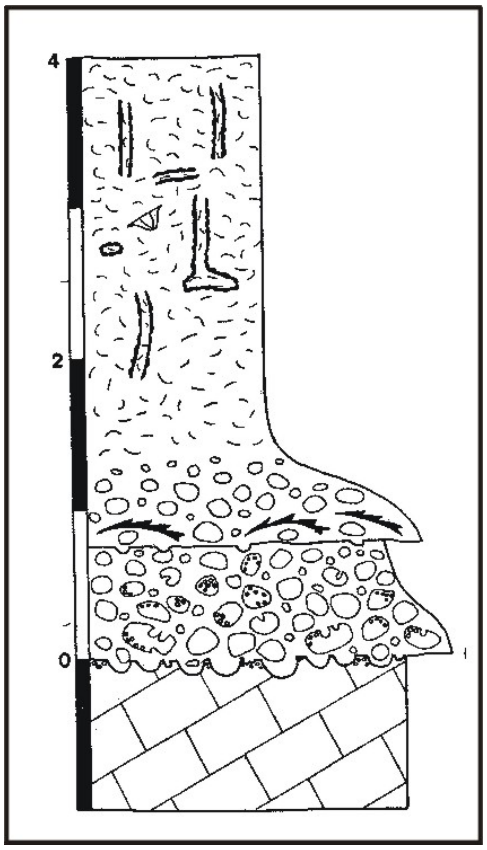
STOP 2. AQÜEDUCTE DE LES FERRERES



The aqueduct of les Ferreres, also known as Pont del Diable (Devil´s Bridge) is located near Tarragona. It was constructed during the time of maximum apogee of Tarraco, in the 1st century A.D. The highest point reaches 23,7 m and its length is 217 m.

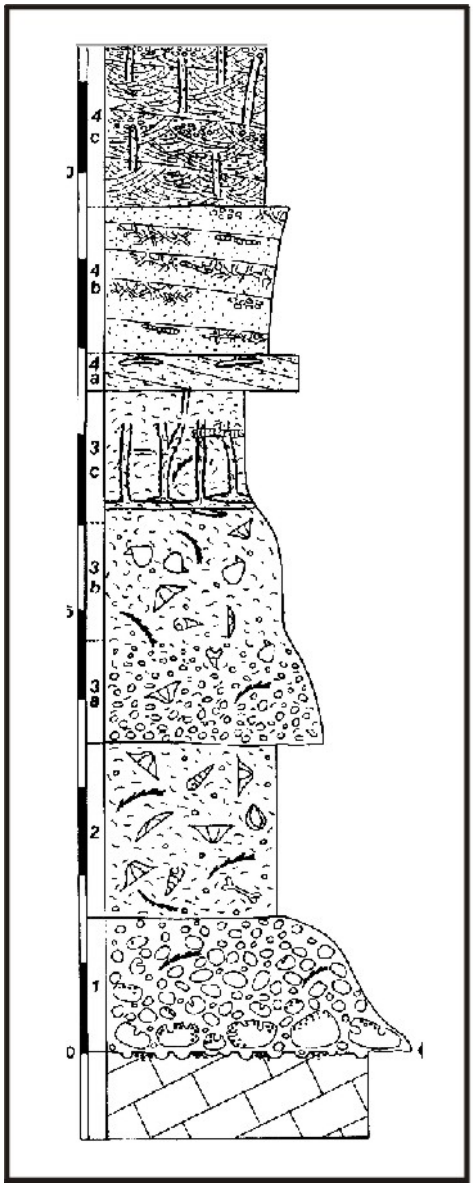
STOP 3. FORTÍ DE LA REINA

At this locality the unconformity between the Miocene (Serravalian) units and the underlying Jurassic dolomites is an extensively bored surface. Borings occupy 90% of the area. The most prominent trace fossils are *Gastrochaenolites torpedo* and *lapidicus*. Another bivalve boring, *Phryxichnus*, is also present together with abundant *Entobia* and common *Maeandropolydora sulcans*. The bored surface is covered by a 1 meter thick conglomeratic bed with echinoids (*Clypeaster* and *Scutella*) and oyster shells. Both, fossils and rocky clasts, show evidences of bioerosion, mainly *Entobia* but also *Gastrochaenolites.* The conglomerates pass gradually to bioturbated calcarenites with *Ophiomorpha*.



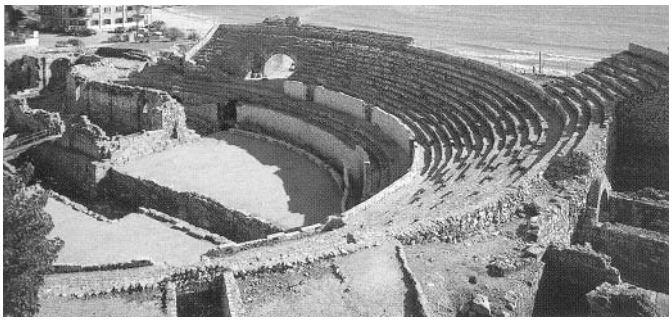
STOP 4. L'ARRABASSADA

At L'Arrabassada the same surface observed at Fortí de la Reina is exposed and hosts a similar trace fossil assemblage. The overlying Miocene section is much thicker here (up to 12 m) and includes conglomerates, calcarenites, coquines and sandstones. Trace fossils, both bioturbation (*Ophiomorpha, Dactyloidites,* etc.) and bioerosional structures are common.



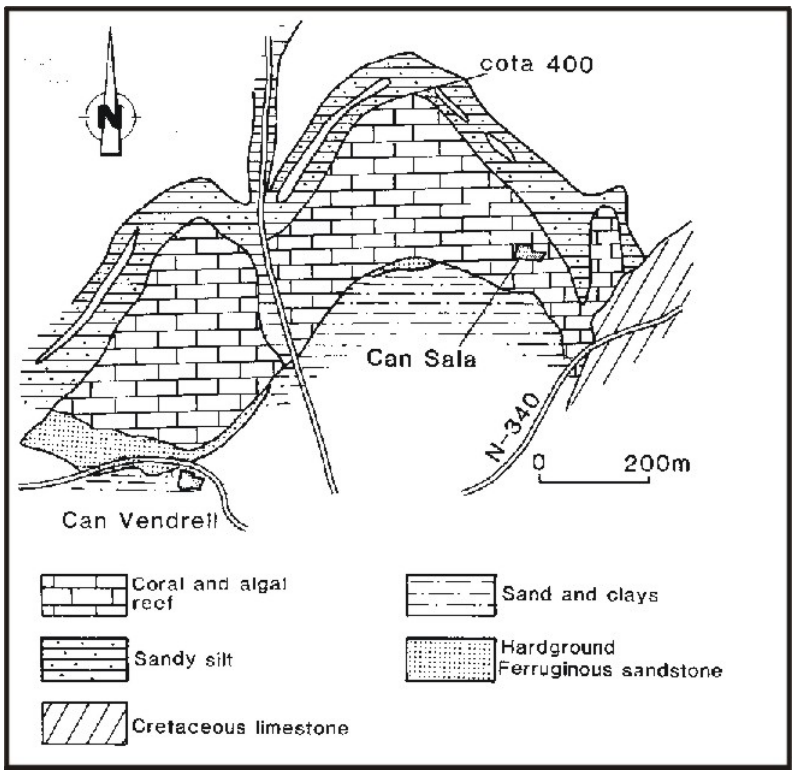
STOP 5. TARRACO

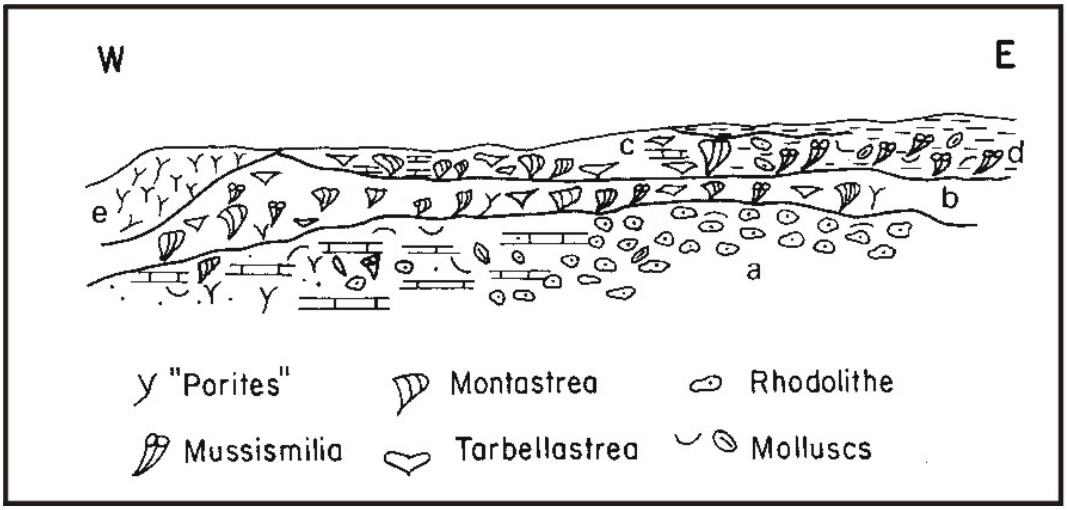
The city of Tarragona was founded by the Romans as Tarraco in the year 218 B.C. Two centuries later (27 B.C.) the city was designated the capital of the Tarraconian Province and plans were applied to improve its urbanistic level. Some of the most revelant constructions of that time are: the amphitheater (first half of the 2nd century A.D. with a capacity for 14.000 spectators), the circus (1st century A.D.) and the city walls.



STOP 6. CAN SALA

The section at this site consists of Langhian reef and reef-related facies. They overlie a bioclastic bed with bivalves and rodophytes and also Cretaceous dolomites with *Gastrochaenolites*. The reef sequence includes a first unit with big colonies of *Montastrea* and *Tarbellastrea*, followed by a unit dominated by small colonies of *Mussismillia* that are substituted to the top by *Porites*. The reef is capped by an oyster-pectinid-turritellidae calcarenite. The corals within the reef facies show bioerosive traces including *Gastrochaenolites* (with its producers inside, *Litophaga litophaga* and *Jouanettia*), *Entobia* and *Trypanites.*





REFERENCES

Fieldtrip 1:

Agustí J., Domènech R., Julià R. and Martinell J. 1990. Evolution of the Neogene basin of Empordà (NE Spain). Paleontologia i Evolució, Mem. Esp. 2, 251-268.

Gibert J.M. de, Martinell J. and Domènech R. 1998. *Entobia* Ichnofacies in fossil rocky shores, Lower Pliocene, northwestern Mediterranean. Palaios 13, 476-487.

Hoffman A. and Martinell J. 1984. Prey selection by naticid gastropods in the Pliocene of Empordà (Northeast Spain). Neues Jahrbuch Geologie Paläontologie 7, 393-399.

Martinell J. 1982. Borings produced by presumed brachiopods from l'Empordà (Catalunya). Butlletí de la Institució Catalana d'Història Natural 46, 135-139.

Martinell J. and Domènech R. 1987. Actividad bioerosiva en el Plioceno de l'Empordà (Catalunya. Paleontologia i Evolució 20, 247-251.

Martinell J. and Domènech R. 1995. Bioerosive structures on the Pliocene rocky shores of Catalonia. Revista Española de Paleontología 10, 37-44.

Fieldtrip 2:

Cabrera L., Calvet F., Guimerà J. and Permanyer A. 1991. El registro sedimentario miocénico en los semigrabens del Vallès-Penedès y de El Camp: organización secuencial y relaciones tectónica-sedimentación. Libro-guía Excursión 4, I Congreso del Grupo Español del Terciario, 132 p.

Domènech R., Gibert J.M. de and Martinell J. 2000. Ichnological features of a marine transgression: Middle Miocene rocky shores of Tarragona, Spain. Geóbios, in press.

Gibert J.M. de, Martinell J. and Domènech R. 1996. El Mioceno marino entre las playas de l'Arrabassada y El Miracle (Tarragona): aspectos paleontológicos e implicaciones sedimentológicas. Acta Geológica Hispánica 29, 133-148.

Permanyer A. and Esteban M. 1973. El arrecife mioceno de Sant Pau d'Ordal (Provincia de Barcelona). Instituto de Investigaciones Geológicas Barcelona 28, 45-72.