
SECTION THROUGH THE PYRENEES

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This account goes along the ECORs seismic profile across the Pyrenees from south to north. It crosses the Pyrenean foreland foldbelt into the axial zone of the mountain range. The ECORs seismic profile is a deep seismic profile which has been used to show the relative plate movements of the Pyrenean orogen and to reconstruct the mountain belt.

The leading edge of the Pyrenean foreland fold and thrust belt is made up of a series of three main large thrust sheets with piggy back basins. These are the Sierras Marginales, The Mont Sec Thrust and the Boixels Thrusts. The thrust sheets are made up of Jurassic and Cretaceous rocks. They have moved on a decollement layer of Triassic evaporites.

Travelling from Barcelona towards the Pyrenees you cross the Ebro basin. This has been infilled with Oligocene conglomerates and evaporites. The first set of hills is the Sierras Marginales Thrust. This is the youngest in the series of thrusts. The piggy-back basin of the Sierras Marginales is the Ager basin. The Ager basin is very narrow and contains sediments of Eocene age. They are predominantly sandstones and limestones containing Alveolinids and Nummulite foraminifera.

The Mont Sec thrust is the next thrust in the sequence. The Mont Sec Thrust was emplaced during the Palaeocene and early Eocene. The thrust rocks are Jurassic and Cretaceous limestones. They form prominent ridges at the back of the Ager basin. There is no hanging wall anticline present so the top of the thrust must have been eroded off. There is a footwall syncline present in the Eocene sediments.

The Mont Sec Thrust separates the Ager and the Tremp basins. The Tremp basin is filled with Maastrichtian to Palaeocene sediments. The Maastrichtian sediments comprise the Salas Marls and the Aren sandstone Formations. The Salas marls are deep water turbiditic deposits. They came off a continent from the east of the Tremp Basin. The sequence shallows up into the estuarine/fluvial deposits of the Aren Formation. Above the Maastrichtian sediments are the Palaeocene Tremp Formation. These are terrestrial red beds.

Structurally, this basin is enclosed by the Boixels Thrust to the north, the Isona Anticline to the east and the Mont Sec Thrust to the south. The basin pinches out to the east between the Boixels Thrust and the Isona anticline. To the west, the basin goes into the Graus and the Ainsa basins. These three basins are contemporaneous and they have related sedimentological events which represent a change from terrestrial deposits to shelf deposits to deep water turbidites.

The Graus Basin is infilled with sediments from the Ager and Montañana Formations. The Ager Formation is made up of sandstone channels within lagoonal mudstones. They grade up into the Montañana Formation which contains marls and palaeosols with more channel sandstones. The environments change from lagoonal with some rivers cutting through it to terrestrial with river channels. The palaeocurrent direction is predominantly towards the west and the Ainsa basin.

Towards the west, the Montañana formation changes from a fluvial environment to dunes and then a shallow marine shelf environment. These continue until the boundary between the Graus and Ainsa basins. This boundary is clearly marked by the Mediano anticline. This anticline is a lateral ramp of the Mont Sec Thrust. It marks the break in the palaeoshelf into the deeper water Ainsa basin. There are shallow water nummulitic limestones on the break in the shelf next to submarine canyon density flow deposits.

As you go further west into the Ainsa basin the shale to sand ratio increases and there are deeper water turbiditic deposits. These continue up to the Boltaña anticline where there are shallow water limestones deposited. The Boltaña anticline is a lateral ramp of the Sierras Marginales. The Boltaña anticline marks a topographic high and the western edge of the Ainsa basin. To the west of the Ainsa basin is the Pamplona-Jaca basin. It is also filled with turbiditic deposits. Some of them are derived from the Ainsa basin as there is a gap to the north of the Boltaña anticline where the sediment can pass from one basin to the other.

The next thrust in the sequence is the Boixols thrust. The Boixels Thrust is a blind thrust. It comes up beneath the San Cornelli Anticline.

The San Cornelli Anticline is made up of the Jurassic and Cretaceous limestones. The top of the anticline has been eroded off. The village of Abella de la Concha is in the centre of the eroded anticline. A clear thrust surface can be seen here between the Jurassic limestone and the Salas Marls. This is not the main thrust but a splay off it. A clear SC cleavage has developed in the Marls and there are slickensides on the thrust surface.

Travelling through the Boixels thrust towards the axial zone of the Pyrenees, you come into the Nogueras zone. This marks the start of the axial zone. The axial zone comprises a series of thrusts which have formed an antiformal stack. Here there is some backthrusting of the Cretaceous limestone towards the north. In the Nogueras zone it is possible to see the older Triassic sediments. They comprise the Bunter sandstone, the Musschelkalk limestone, the Keuper marls and some basaltic rocks. These igneous rocks are called ophitas but they are not of ophiolitic origin.

To the north of the Nogueras zone is the main part of the axial zone. The oldest rocks in the Pyrenean mountain chain are here. There are rocks from Cambrian to Carboniferous rocks present. The Cambrian to Ordovician rocks are highly metamorphosed. There are slates, marbles and garnet mica schists. The rocks show both brittle and ductile deformation and they have produced a great number of structures.

There is also several igneous intrusions in the axial zone. The largest of these intrusions is the Maladeta granodiorite. This intrusion has produced garnet-rich skarns and some contact metamorphism.