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UGIJAR AND CANJAYAR NEOGENE BASINS (SE SPAIN): AN EXAMPLE OF STRIKE-SLIP BASIN EVOLUTION IN TRANSPRESSIVE REGIME

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Riassunto. Questo studio è stato condotto nella parte orientale del "Corridoio delle Alpujarridi" sulla Catena Betica, un bacino orientato E-O lungo 80 km, di età neogenico-quaternaria. E' stata rivolta particolare attenzione ai bacini di Ugijar e di Canjayar (denominati bacini 1 e 2, rispettivamente), controllati nel loro sviluppo da un sistema di faglie E-O a componente di trascorrenza destra, associato con faglie inverse orientate NE-SO.

La successione stratigrafica dei due bacini, di oltre 2.000 m di spessore, risulta soprattutto connessa a subsidenza tettonica ed è interpretata in termini di stratigrafia sequenziale; l'attribuzione al Serravalliano superiore-Pliocene è stata definita mediante i Foraminiferi planctonici.

Sono state osservate sei Sequenze Deposizionali: dal Serravalliano superiore al Tortoniano inferiore i caratteri stratigrafici delle Sequenze 1 e 2 mostrano uniformi condizioni di sedimentazione in entrambi i bacini; nella parte alta del Tortoniano inferiore, con l'inizio della terza Sequenza, la distribuzione delle facies sedimentarie comincia a differenziarsi sottolineando l'evoluzione longitudinale dei due bacini.

Il confronto con i cambiamenti relativi della curva dell'onlap costiero (Haq et al., 1987) evidenzia il forte controllo tettonico sui caratteri della sedimentazione, specialmente riguardo alle Sequenze 2, 3 e 5. L'evoluzione nello spazio e nel tempo delle facies sedimentarie, da O verso E, si accompagna alla migrazione della deformazione tettonica che avviene nella medesima direzione.

Abstract. The present study has been carried out in the eastern part of the Alpujarran corridor (Betic Chain), an E-W trending basin, 80 km long, of Neogene-Quaternary age. In particular, the Ugijar and Canjayar basins (respectively named Basin 1 and Basin 2), controlled by an E-W trending left stepping right lateral strike-slip system, associated with NE-SW trending thrust faults, have been investigated. The stratigraphic sequence of the forementioned two basins, which can be up to 2000 m thick, is mainly due to tectonic subsidence and is here interpreted in terms of Sequence Stratigraphy. The age of the whole sequence, dated by means of planktonic foraminifera, is Late Serravallian-Pliocene.

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Six depositional sequences have been observed: from Late Serravallian to Early Tortonian the stratigraphic setting of Sequences 1 and 2 shows uniform conditions both in the Ugijar and Canjayar basins, with the beginning of the third Sequence (Late Early Tortonian) the distribution of sedimentary facies outlines the longitudinal evolution of the two basins, the sedimentation pattern of which starts to differentiate.

The comparison with the relative change of coastal onlap curve of Haq et al. (1987) puts to evidence the strong influence of a tectonic control over the sedimentation pattern, especially with respect to Sequences 2, 3 and 5. The evolution in time and space of the sedimentary facies, from W to E, follows the migration of the tectonic deformation, which occurred in the same direction.

Introduction.

In the Betic Chain an E-W trending Neogene-Quaternary basin 80 km long, located between the Sierra Nevada and the Sierras de Laujar, Contraviesa and Gador develops (Fig. 1). The basin, called "the Alpujarran Corridor" by Sanz de Galdeano et al. (1985) is situated in the inner Betic zone, at the boundary between the Nevado-Filabrides and the Alpujarran Units. Sanz de Galdeano et al. (1985) pointed out the importance of two discernible bands of strike-slip faults that mark the northern and southern margins of the basin. Italian geologists, in collaboration with the forementioned spanish researchers, recognized a strong interaction between the E-W trending strike-slip faults

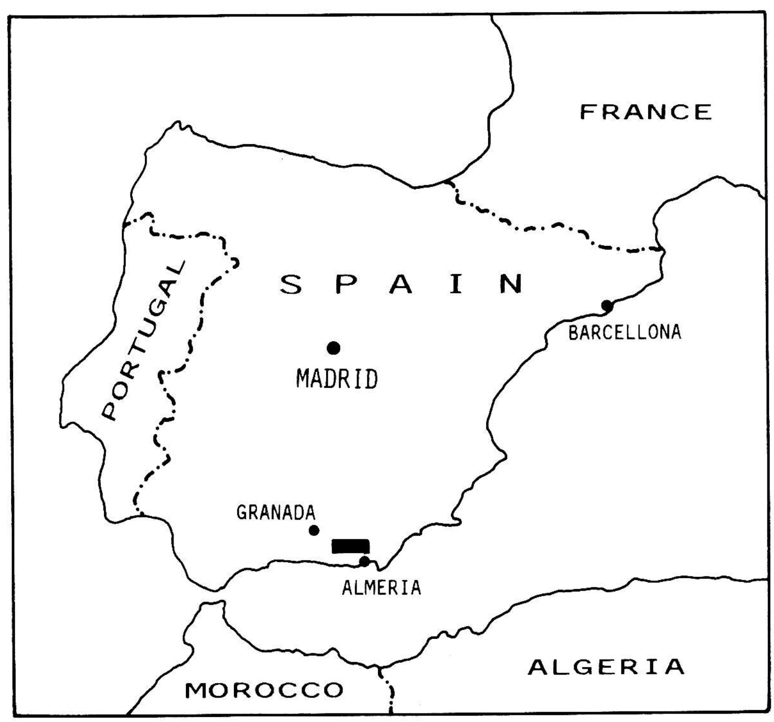


Fig. 1 - Location of the study area.

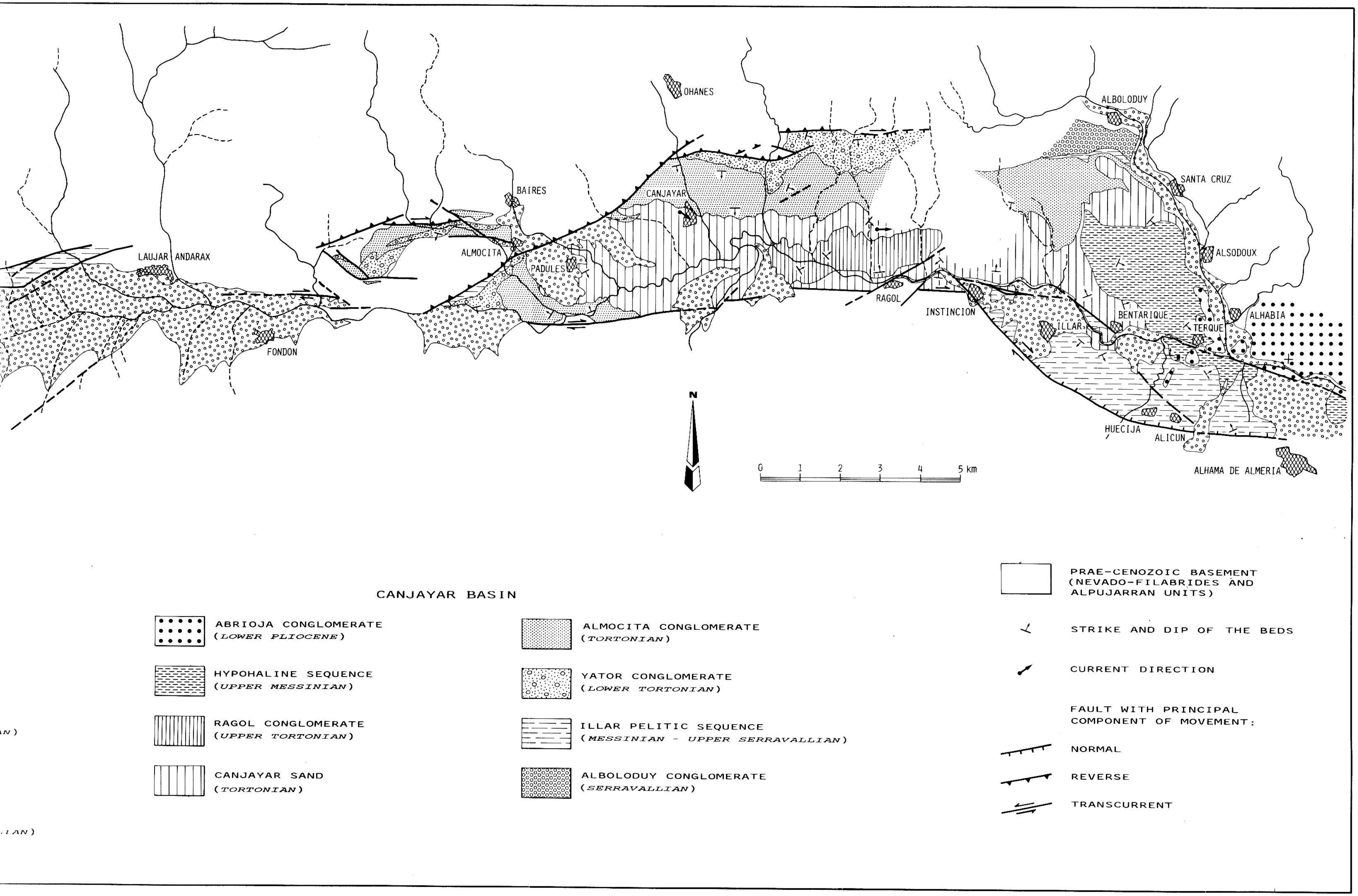
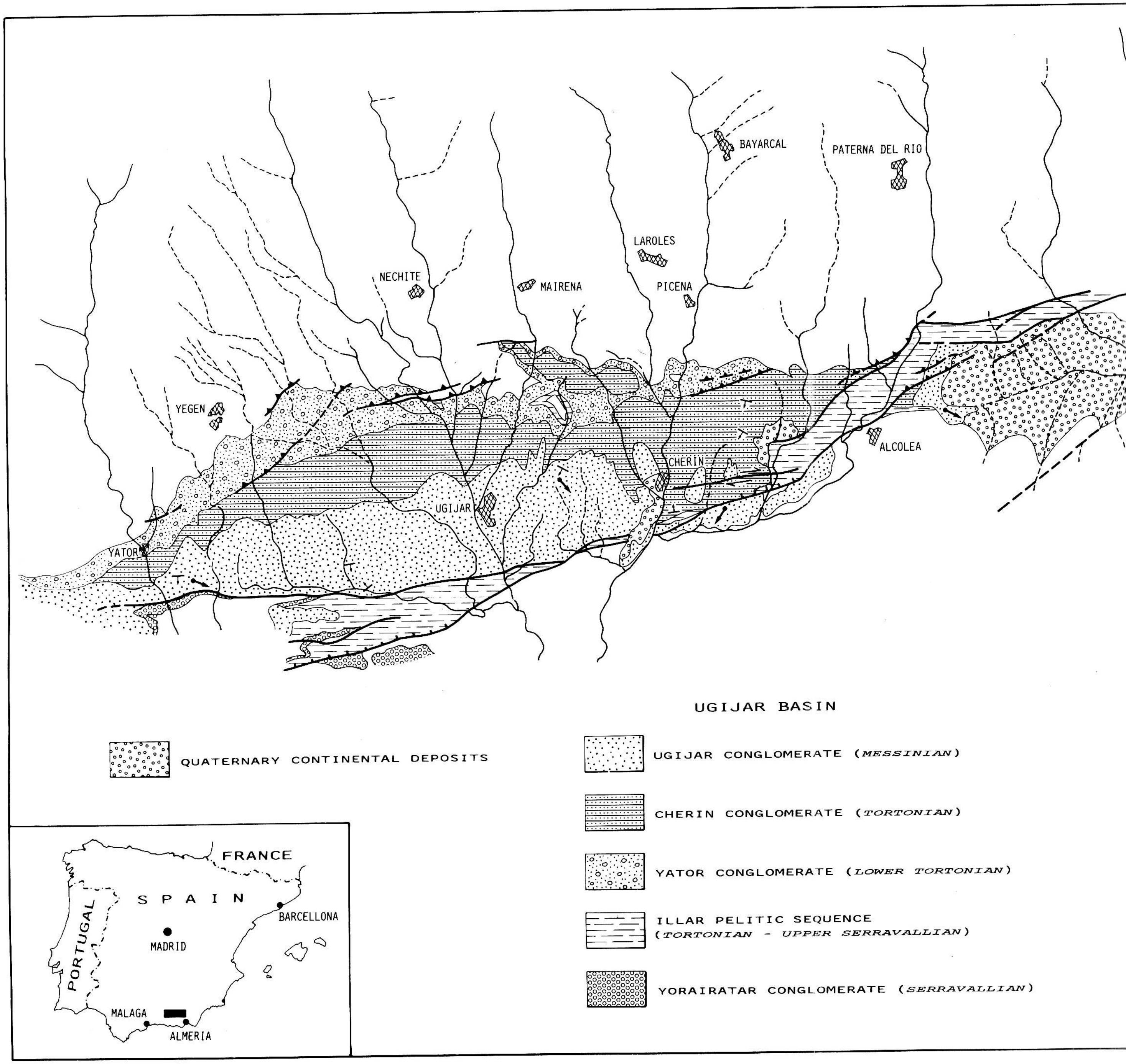


Fig. 2 - Geological sketch map of the "Alpujarran Corridor".



BAYARCAL
PATERNA DEL RIO
LAROLES
NECHITE
MAIRENA
PICENA
YEGEN
ALCOLEA
CHERIN
UGIJAR
YATOR
UGIJAR BASIN
QUATERNARY CONTINENTAL DEPOSITS
UGIJAR CONGLOMERATE (MESSINIAN)
CHERIN CONGLOMERATE (TORTONIAN)
YATOR CONGLOMERATE (LOWER TORTONIAN)
ILLAR PELITIC SEQUENCE
(TORTONIAN - UPPER SERRAVALLIAN)
YORAIRATAR CONGLOMERATE (SERRAVALLIAN)
FRANCE
SPAIN
PORTUGAL
MADRID
BARCELLONA
MALAGA
ALMERIA

Fig. 2

and two other fault systems, respectively dextral and sinistral, NW-SE and NE-SW trending, in the whole Betic Chain.

Our research has been carried out in the eastern part of the Alpujarran Corridor, in two smaller basins named Ugijar and Canjayar (respectively named Basin 1 and 2), separated by the Laujar structural high. We developed both a structural and stratigraphic analysis of the area, along with the geologic mapping at a 1:50,000 scale (Fig. 2).

This paper deals with the analysis of the mapped lithostratigraphic bodies and with their possible organization in depositional sequences.

Structural setting.

At the International Workshop on "Active and Recent strike-slip tectonics" held in Florence from the 18th to the 20th of April, 1989, the structural setting of the studied basins has been the subject of a communication. Therefore, we give here a brief synthesis in order to set the sequence of stratigraphic events in its tectono-sedimentary frame.

The sedimentation in the two basins is controlled by a system of E-W trending strike-slip faults associated with NE-SW trending thrust faults. The E-W trend shows a left-stepping, right-lateral, strike-slip system geometry and outlines, almost without interruption, the northern and southern boundaries of the two basins, with strong transpressive features in the northern side.

The NE-SW trending faults bound the western margin of Basin 2 and the eastern and western margins of Basin 1. This latter system is responsible for the formation of both synsedimentary folds, with the same orientation, and the resedimentation processes frequently observed in the neogenic deposits.

The stratigraphic sequence.

The Ugijar and Canjayar basins stratigraphic sequence, up to 2000 m thick, consists of marine and continental deposits of Late Serravallian to Pliocene age (Fig. 3). The depositional pattern is very similar in the two basins up to the Middle Tortonian, then it differentiates.

As for what can be observed in the margin areas, the sequence starts with Upper Serravallian pelites (Illar Pelitic Sequence) at the bottom, transgressive either on the Alpujarride basement, or on fan delta conglomerates (Yorairatar and Alboloduy Conglomerates). The pelites are followed upwards by lower Tortonian resedimented conglomerates (Yator Conglomerate). The subsequent deposition is characterized by conglomerates and sandstones, organized both in marine and continental formations, locally separated by unconformities, which show different features from one basin to the other.

In Basin 1 we observed, from the bottom to the top: the Tortonian Cherin Conglomerate and the Messinian Ugijar Conglomerate. In Basin 2, the following sequence outcrops: deltaic deposits (Almocita Conglomerate), platform deposits (Canjayar Sand), alluvial deposits (Ragol Conglomerate) laterally passing to the Illar pelites towards the

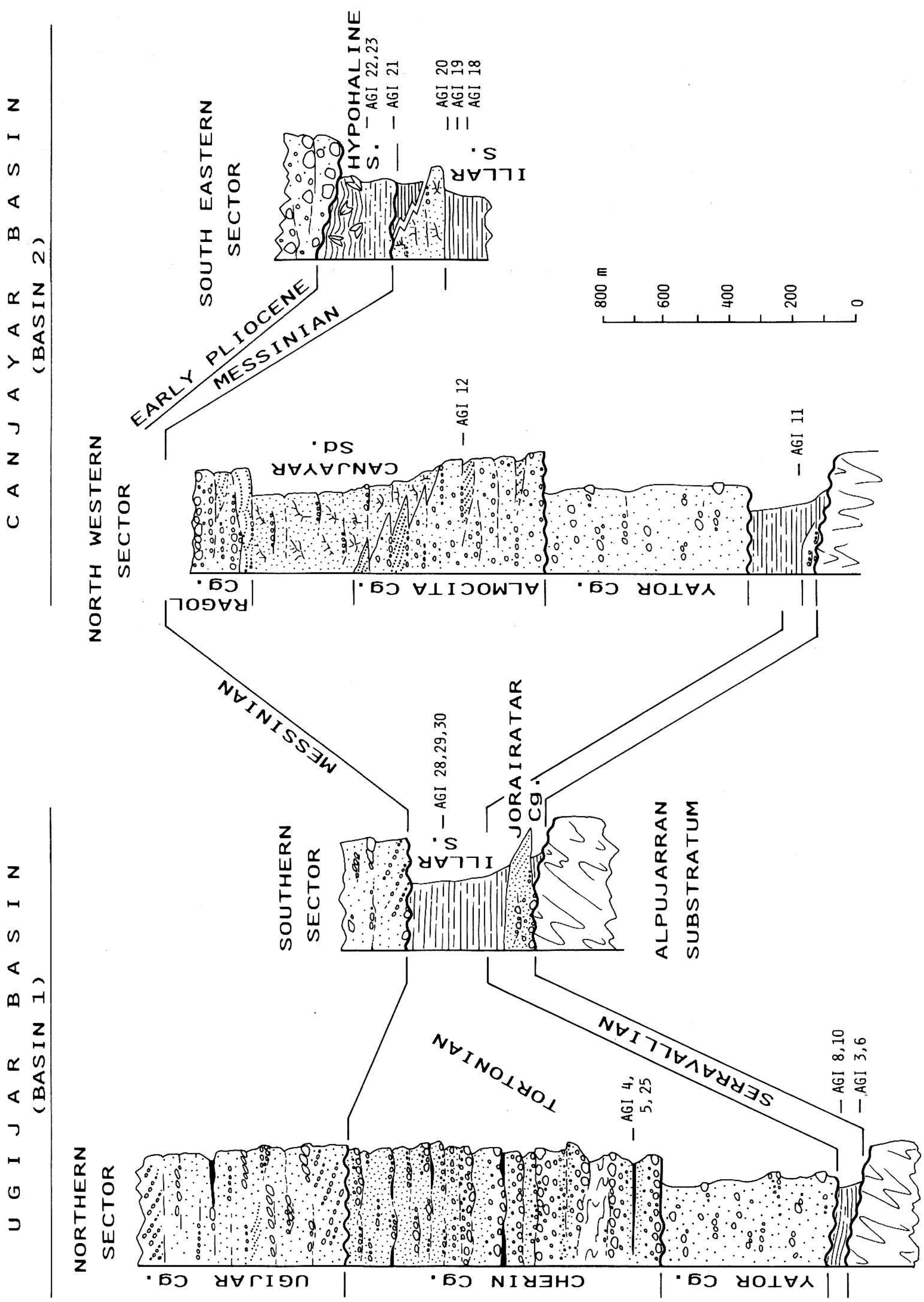


Fig. 3 - The stratigraphic sequences of the Ugijar and Canjayar basins in the "Alpujarran Corridor".

eastern margin of the basin. The Late Messinian Hypohaline Sequence and overlying Early Pliocene deltaic conglomerates follow.

The lithologic and sedimentologic characters of the part of the sequence that the two basins share in common are as follows.

Yorairatar Conglomerate and Alboloduy Conglomerate.

Sequences of alluvial to marginal marine conglomerates and sandstones probably belonging to a fan delta system. In the Ugijar basin the most continuous outcrop can be observed at the first kilometer along the Ugijar-Yorairatar road, where we recognized: disorganized layers (one to a few meter thick) of coarse purplish sandstones, with polymodal grain-size distribution and granules either sparse or arranged in rows; lenses, one to a few meter thick, of conglomerates with quartz pebbles. These lenses show a scoured base and graded structures.

The whole clastic sequence, up to 100 m thick, interdigitates with light grey pelites towards the inner part of the basin (Cortijos de los Banos).

In Basin 2 the conglomerates outcrop only at the westernmost edge of the northern margin, at Tajo Negro, along the road to Ohanes and towards Alboloduy. In this latter locality, red, poorly sorted and massive conglomerates containing crystalline schist pebbles can be observed.

Illar Pelitic Sequence.

Its best outcrops can be seen at the southern margins of the two basins, where the sequence consists of light grey marls, with thin-bedded turbiditic sandstones in its lower part (Rambla Seca, Ugijar Basin).

This sequence overlies either the Alpujarride basement or the above mentioned conglomerates. Its stratigraphic relationship with the Alpujarride basement is still preserved in the central and northern areas (Rambla de Bombaron) as well as in the eastern part (Alcolea) of the Ugijar basin. With respect to the conglomerates, in the Alboloduy area an onlap relationship can be observed.

The Illar Pelitic Sequence covers the time interval Upper Serravallian-Tortonian in the Ugijar Basin, while in the Canjayar Basin it stretches to the Lower Messinian.

Yator Conglomerate.

These conglomerates outcrop without interruption in the northern margin of the Ugijar Basin, where they reach a thickness of up to 500 meters. The Yator Conglomerate consists of massive, matrix-supported, red (locally grey), disorganized polymictic conglomerates containing a variety of pebbles and boulders. They show extensive resedimentation features (debris flows and slidings) triggered by sinsedimentary tectonic activity.

The Yator Conglomerate is either directly overlying the basement or lies unconformably on the Illar Pelitic Sequence (Rambla de Bombaron and Almocita). Towards the basin the conglomerates pass laterally to the Illar pelites.

The top of the Yator Conglomerate marks the beginning of the differentiation in the depositional pattern within the two basins.

In Basin 1 the pre-neogenic deposits are followed upwards by the Cherin and Ugijar Conglomerates.

Cherin Conglomerate.

A turbiditic sequence up to 1000 m thick consisting of both fining upwards and coarsening upwards massive conglomerate in beds and lenses displaying a scoured base, often organized in decametric negative megacycles. The Cherin Conglomerate represents "proximal" turbidites, generally overlying the Yator Cg. It onlaps, in the eastern marginal area of the basin, both the pelites and/or the substrate with thin-bedded and more fine-grained turbidites.

The presence of syntectonic and progressive angular unconformities in the upper part of the sequence (Rio de Ugijar), which prelude to its emersion and subsequent partial erosion, indicates the importance of tectonic control on the sedimentation pattern. Furthermore, we believe that tectonics is responsible for the slumping phenomena observed in different stratigraphic positions within the formation.

Ugijar Conglomerate.

This formation consists of a sequence, more than 600 m thick, of massive, well sorted, alluvial conglomerates showing frequent festoons and imbrication, indicative of NW trending paleocurrents. The Ugijar Cg. locally displays disordered structures, probably due to seismic shocks.

An unconformity separates the Ugijar Conglomerate from the underlying Illar Pelitic Sequence and Yator Conglomerate, in the western area, as well as from the Alpujarride basement, in the southern margin, and from the Cherin Conglomerate.

In Basin 2 the sequence consists of the followings:

Almocita Conglomerate.

Clast-supported conglomerates, poorly graded, interfingered with sandstones with intercalated layers of aligned pebbles. These sandstones form lenticular bodies, several meter thick, showing cross-bedding and containing sparse *Ostreae.* In the northern and western marginal areas of the Canjayar basin, the Almocita Conglomerate unconformably overlies the Yator Conglomerate.

Canjayar Sand.

This formation represents platform facies, transgressively overlying the Almocita Conglomerate. It consists of sands showing homogeneous textures, pervasive bioturbations and less frequent fine parallel lamination. Small conglomerate lenses (which may be graded) and slumping phenomena intercalate within the sands.

These features, as well as the progressive change of the lithofacies from coarser to finer textures, suggests an eastward transition towards slope or basinal facies (i.e. Illar Pelitic Sequence).

Ragol Conglomerate.

This formation can be observed along the basin axis (North of Ragol) at the top of the Canjayar Sand. It consists of a sandstone-conglomerate sequence showing festoons, poorly graded structures and imbricated pebbles.

It conformably overlies the Canjayar Sand indicating the progradation of the alluvial deposits on the platform. It is probable that Lower Messinian evaporitic sediments were deposited at the eastern margin of the outcrops. However, these have been totally dismantled and partially redeposited within the Hypohaline Sequence.

Hypohaline Sequence.

The lower contact of this sequence is marked by an unconformity, as it can be observed along the eastern margin of the basin, between Bentarique and Alboloduy, which can be ascribed to the intra-messinian event. The sequence represents hypohaline continental facies. In the Almeria and Alhama zone these facies consist of rhythmic pelites and siltites containing fresh water ostracodes and resedimented blocks of gypsum of various sizes. The Hypohaline Sequence is topped by a surface of erosion.

Early Pliocene Abrioja Formation.

This formation outcrops only in the easternmost part of the studied area and consists of mature conglomerate, which can be ascribed to the Abrioja Fm. deltaic depositional system described by Postma (1979, 1983).

Biostratigraphy and chronostratigraphy.

We sampled exclusively the pelitic layers of well defined stratigraphic horizons of the following formations: Illar Pelitic Sequence, Cherin Cg., Canjayar Sand and Hypohaline Sequence. The micropaleontological analysis has been carried out mainly on planktonic foraminifera; as for their chronostratigraphic significance we referred to the biostratigraphic zonation of Iaccarino (1985).

The lower part of the Illar Pelitic Sequence contains Upper Serravallian fauna (*G. siakensis* Zone) in the northern margin of the Ugijar Basin area. Here we found highly recrystallized foraminifera associations with *Globigerina venezuelana, G. bulbosa, G. quinqueloba, Globigerinoides obliquus obliquus, G. subsacculifer, G. quadrilobatus, Globorotalia* cf. *siakensis, G. acostaensis, G. scitula, G. obesa, Globoquadrina baroemenensis, Orbulina universa, O. suturalis.* The rare occurrence of *Globigerinoides bisphaericus* has been interpreted as due to reworking. Benthonic foraminifera are mainly represented by: *Bolivina punctata, Bulimina costata* and *Uvigerina rutila.*

The upper part of the Illar pelites, which has been sampled at different stratigraphic horizons in the two basins, contains tortonian associations (*G. obliquus extremus* Zone) with *Globigerinoides obliquus extremus, G. trilobus, G. sacculifer, G. quadrilobatus, Globorotalia acostaensis, G. continuosa, G. praehumerosa, G. miotumida, G. menardii* gr., *G. scitula, G. obesa, Globigerina bulloides, G. apertura, G. quinqueloba, G. nepenthes, Hastigerina siphonifhera, Globigerinita glutinata.* The benthonic foraminifera are represented by: *Uvigerina rutila, U. mediterranea, U. peregrina, Bulimina costata, B. ovata, Chilostomella oolina* as well as the arenaceous *Martinottiella communis* and *Bigenerina nodosaria* and large recrystallized rotaliids.

The Illar Pelitic Sequence most recent stratigraphic layers outcrop at the southeastern end of the Canjayar Basin, near Illar. The microfauna is here characterized by: forms evolving from *Globorotalia miotumida* to *G. conomiozea, Globigerina multiloba, G. merotumida, G. nephentes* and transition forms to *G. humerosa.* The benthos is dominated by smooth buliminids of the *B. elongata* group similar to those found in the messinian sediments of the Vera basin (Cita et al., 1980) associated with *Globorotalia conomiozea.* Therefore, the observed association can be ascribed to a Lower Messinian deep marine facies.

The Cherin Conglomerate contains, from the bottom to the top, scarce, recrystallized and deformed fossils. However, we could recognize: *Globorotalia acostaensis, G. praehumerosa, G.* cf. *continuosa, G. obesa, G. scitula, Globigerinoides obliquus extremus, Globigerina bulloides, G. bulbosa, G. quinqueloba.* As for the benthonic forams, the following genera have been recognized: *Uvigerina, Eponides, Cibicides, Florilus.* This association allows us to ascribe the Cherin Conglomerate to the Tortonian (*G. obliquus extremus* Zone).

The lower part of the Canjayar Sand, near its contact with the underlying Almocita Conglomerate has been sampled, however, we did not find any significant association to determine the age of the sediments. The samples coming from the westernmost outcrops include one association which can be assigned to the Upper Tortonian (upper part of the *G. obliquus extremus* Zone). In fact it includes transitional forms from *Globorotalia miotumida* to *G. conomiozea.* This association also consists of the planktonics: *Globorotalia* gr. *menardii, G. praehumerosa, G. scitula, Globigerinoides obliquus extremus, G. quadrilobatus, G. subsacculifer, G.* cf. *emeisi, Globigerina apertura, G. bulloides, G. bulbosa, G. quinqueloba, Orbulina universa.* The benthonic forams are represented by: *Brizalina arta, Bolivina* cf. *punctata, Bolivina* sp., *Uvigerina rutila, U. peregrina, U. mediterranea, Bulimina ovata, Rectuvigerina* sp., *Gyroidina altiformis, Planulina ariminensis, Cassidulina subglobosa,* as well as *Heterolepa praecincta* in oligotypic association with *Marginulina costata.*

In the eastern sectors of the basin we found a slightly older Tortonian association consisting of: *Globorotalia acostaensis, G. scitula, G. praehumerosa, Orbulina universa, Globigerina bulloides, G. bulbosa, G. apertura, G. quinqueloba, Globigerinoides obliquus* (*G. obliquus extremus* Zone).

The Hypohaline Sequence contains an upper messinian fauna, consisting of benthonic forams and ostracodes of the "Lagomare" facies. Part of the analyzed samples are barren, with iron oxides, plant remnants, carbon residues, gypsum and microcrystalline aggregates. The other part contains: *Ammonia beccarii tepida* in association with *Textularia* sp., *Nonion* sp. or *Protoelphidium paralium.* In some samples *Bulimina echinata* occurs frequently. Ostracodes can be both smooth and with punctae, and belong to the genus *Euxinocythere.*

Sequence stratigraphy.

The occurrence of unconformities in the marginal areas of the two studied basins, as well as the spatial distribution of the sedimentary facies, allowed us to attempt the division of the neogenic succession into Depositional Sequences (Fig. 4). Furthermore, we tried to discriminate between tectonics and eustacy as a cause for the neogenic depositional pattern by means of the individuation of System Tracts within each Sequence and their correlation with the Third order Cycles of Haq et al. (1987) connected with the relative change of coastal onlap.

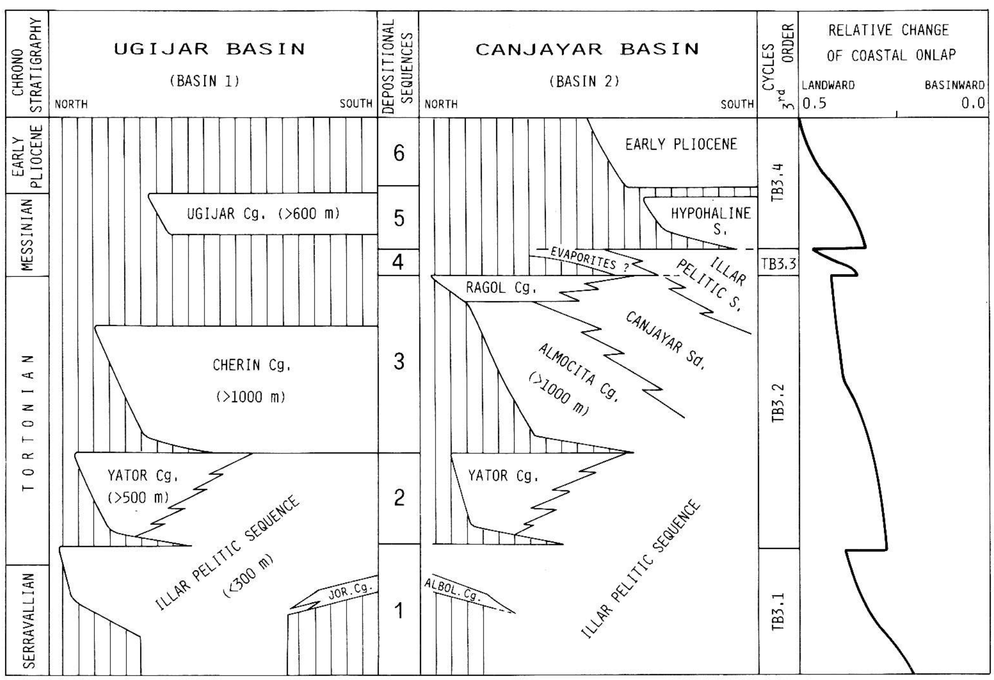


Fig. 4 - The Depositional Sequences of the Ugijar and Canjayar basins in the "Alpujarran Corridor".

Depositional Sequence 1 (Late Serravallian-Early Tortonian).

It consists of the Yorairatar Cg., Alboloduy Cg. and Illar Pelitic Sequence (pars). Its lower contact with the underlying substrate is marked by an angular unconformity.

The LST might be represented by the conglomerates outcropping in the basin marginal areas and by the thin turbidites observed at the bottom of the pelitic sequence towards the basin axis.

The TST is defined by the retrogradation of the pelites with respect to the Joraitar Cg. Then, the other part of the Sequence seems to develop entirely within the pelites. In particular, evidence for the maximum flooding surface is given by the observed direct superposition of the pelites onto the Alpujarride basement in the eastern margin area of the basin which corresponds to the Laujar (Alcolea) high.

We believe that this Sequence can be correlated with the Third order Cycle (TB3.1) of Haq et al. (1987). The eustatic control on the sedimentation pattern is fundamental in the development of the sedimentary facies.

Depositional Sequence 2 (Early Tortonian).

It is represented, in both basins, by the mass-resedimented Yator Cg. and by its laterally equivalent pelites of the Illar Pelitic Sequence. In the north-western marginal areas of the Ugijar basin, the sequence lower limit is represented by an erosional surface developed on the Alpujarride substratum.

We interpret the prograding of the Yator Cg. onto the pelites as belonging to the LST (Lowstand prograding Wedge=LSW). We did not find any evidence for a regular upwards evolution through TST and HST, therefore we believe that this anomaly might be a consequence of an important tectonic control, as it might be indicated by the occurrence of synsedimentary folds in the western margin of the Ugijar basin. Tectonics is responsible for the continuous eastward progradation of the conglomerates onto the pelites, despite the global rise of sea level.

This Sequence might correspond to the lower part of the TB3.2 Cycle of Haq et al. (1987).

Depositional Sequence 3 (Late Tortonian).

The sedimentary facies development of this Sequence in the Ugijar basin is remarkably different from that of the Canjayar basin. However, in both basins the lower boundary of the Sequence is a well defined unconformity, despite the fact that the global eustatic curve indicate, in this period, a rise of sea level. Therefore tectonics is the primary cause for the presence of the unconformity.

In the Ugijar basin the turbiditic Cherin Cg. covers the entire thickness of the Sequence. In analogy to Sequence 2, we believe that its sedimentary evolution was controlled by tectonics. In fact, in the upper part of the Cherin Cg. progressive and syntectonic angular unconformities have been observed.

In the Canjayar basin a platform sequence (Canjayar Sd.) retrogrades on deltaic deposits (Almocita Cg.) thus putting to evidence the TST. The alluvial deposits of the Ragol Cg. may be referred to the subsequent HST. The LST of Sequence 3 should be looked for in the eastern areas of the basin, which do not outcrop.

In this basin the tectonic phenomena that caused the beginning of the sequence are indicated by progressive and syntectonic angular unconformities in its western margin, within the lower part of the Almocita Cg.

Depositional Sequence 3 can be correlated with the upper part of the TB3. 2 Cycle of Haq et al. (1987).

Depositional Sequence 4 (Early Messinian).

This Sequence is represented by Lower Messinian pelites outcropping in the eastern margin area of the Canjayar basin (Illar zone). The pelites do not have clear stratigraphic relationships with the other part of the sequence. We believe that autochthonous evaporites, lately eroded, should be correlated with the pelites of this sequence.

Depositional Sequence 4 can be correlated with Cycle TB3.3 of Haq et al. (1987).

Depositional Sequence 5 (Late Messinian).

It consists of the alluvial Ugijar Conglomerate, in the Ugijar basin, and the Hypohaline Sequence, in the Canjayar basin. The lower contact of this sequence is characterized by a marked angular unconformity in both basins.

The upper part of the Hypohaline Sequence contains resedimented evaporites. This confirms the existence, landwards, of autochthonous evaporites. Therefore, Sequence 5 should be correlated with the lower part of TB3.4 Cycle of Haq et al. (1987). Therefore, Cycle TB3.3 may be equivalent to the completely eroded Evaporite Sequence.

The angular unconformity marking the base of TB3.4 allows us to support tectonic phenomena as responsible for the aforementioned erosion.

Depositional Sequence 6 (Early Pliocene).

This Sequence is represented, only in Basin 2, by deltaic conglomerates of the Abrioja Fm., and characterized by a marked erosional truncation at its lower contact (incised valley fill). In the present study we did not take it into consideration.

Concluding remarks.

The analysis of the two basins allows us to suggest that their tectono-sedimentary evolution, from Late Serravallian to Early Pliocene, is characterized by the migration of tectonic phenomena and facies distribution from W to E. Subsidence in the two basins is related to tectonic phenomena. In fact, it is connected with movements which occurred along E-W and NE-SW faults.

From Late Serravallian to Early Tortonian (Sequence 1 and 2) the stratigraphic setting is characterized by uniform conditions, indicative of a probable connection of the two basins from the physiographic point of view. In particular, in Late Serravallian there was a sudden drowning of the continental conglomerates followed by the deposition of the hemipelagic Illar Pelitic Sequence.

During Early Tortonian, huge conglomerate bodies, dominated by debris flow (Yator Cg.), deposited with a maximum thickness near the northern and northwestern margins of the basins. Therefore, the transverse profile of the two basins is asymmetric, and this may be a consequence of compressive and transpressive tectonics occurring along the fault systems located in the western and northern borders of the basins (Fig. 5).

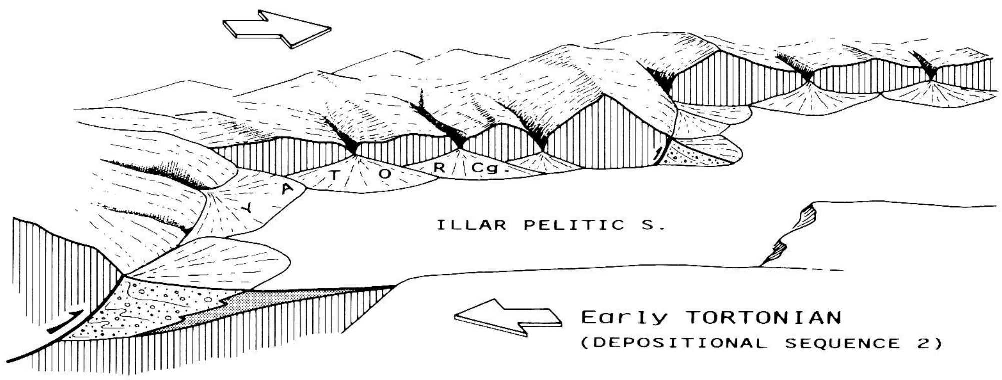


Fig. 5 .- The depositional and tectonic model for the Ugijar and Canjayar basins in the Early Tortonian.

In the late Early Tortonian, with the beginning of the third Depositional Sequence, the facies distribution outlines the longitudinal evolution of the sedimentation pattern through time and space in the two basins, which begin to differentiate (Fig.6). In Basin 1 the turbiditic Cherin Cg. can be related to the tectonic activity of the NE-SW fault system in the western margin of the basin. The syntectonic activity in the Cherin Cg. is also indicated by the presence, in areas located near the margins, of mass resedimented slabs belonging to the underlying Yator Cg. and by composite syntectonic progressive unconformities, which can be observed in its uppermost part.

In the same period, the Laujar structural high begins to develop its present-like physiography. As a consequence, the depositional pattern in the two basins starts to differentiate. Also in Basin 2 the beginning of Sequence 3 seems to be tectonic-controlled in its western margin. Therefore, the subsequent development of the Sequence may be partially conditioned by the global rise of sea level, as it can be seen from the cyclic facies distribution.

If we compare the sedimentary evolution of the two basins from Tortonian to Messinian, we observe a shift of marine regression from west to east. In the Ugijar basin, following the Early Messinian erosional phase, the huge thickness of the alluvial Ugijar Cg. outlines a strong subsidence. Moreover, the intra-Messinian tectonic activity is evidenced by seismic shoks sedimentary structures. In Basin 2 the intra-Messinian tectonic activity develops in two distinct events represented by gentle folding of the pre-Messinian sequence and by the resedimentation of gypsum blocks in the Late Messinian Hypohaline pelites.

A marked erosional surface truncates the Hypohaline deposits and is then filled by the alluvial-deltaic Abrioja Fm., corresponding to the Depositional Sequence 6 of the Early Pliocene.

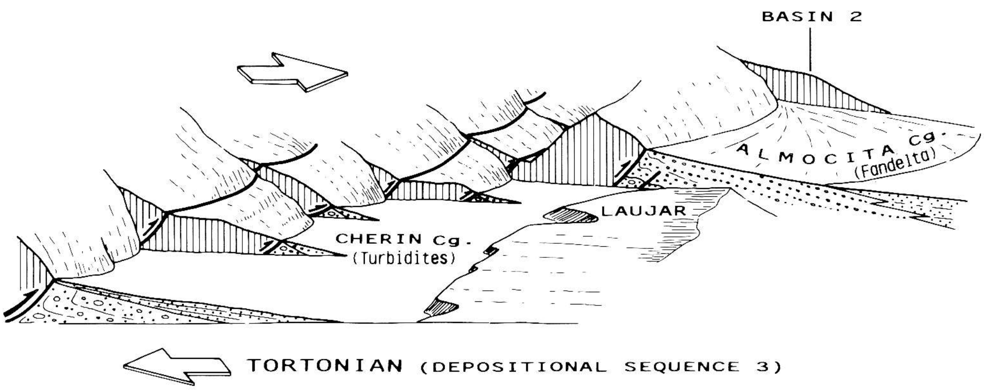


Fig. 6 - The depositional and tectonic model for the Ugijar and Canjayar basins in the late Early Tortonian.

Our conclusions are essentially drawn on the attempt to discriminate the importance of tectonics and eustacy as the cause for the observed depositional patterns. The structural analysis, which we did not discuss in this paper, is necessary as a support to our hypothesis. In fact, the distribution of sedimentary facies has been considered, where possible, in strict association with the information provided by structural analysis. Furthermore, the latter has been better understood after examining the data coming from the chronologic reconstruction of the sedimentary events. Our proposed correlation with the third order Cycles of Haq et al. (1987) is valid only within the limits given by the interpretation of sedimentary facies and its validity could be tested studying the global evolution of the Mediterranean area. Furthermore, the studied basins can be ascribed to the "sillons sur décrochement" (wrench furrows) observed by Montenat, Ott d'Estevou and Masse (1987) in the eastern Betic zone. However, there is a fundamental difference: in the Ugijar and Canjayar basins the crustal characters of the two blocks involved in the transpressive shear zone do not seem to be much different and they reveal only an abrupt change of the crustal thickness (De Larouzière et al., 1988).

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