Insights into the upper aptian carbonate succession of the south-eastern maestrat basin (e iberia)

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Summary

A transgressive-regressive (T-R) sequence stratigraphic approach was performed along the Upper Aptian carbonate sedimentary record cropping out in the south-eastern Maestrat Basin with the result that three T-R sequences within a low-frequency sea-level cyclicity were recognized. A transgressive ravinement surface and a maximum regressive surface bound the sequences. Syn-rift subsidence played the most significant part in creating accommodation space as deduced from the considerable thickness of the sedimentary succession (around 1500-m-thick) and the presence of fossilized syn-sedimentary faults.

Introduction

Exceptionally exposed Upper Aptian outcrops bordering the Mediterranean Sea give rise to the Serra d'Orpesa in the south-eastern part of the Maestrat Basin (Iberian Chain; E Iberia; see Fig. 1). This marine carbonate succession, which belongs to the Benassal Formation, is around 1500-m-thick and was deposited in a tectonically active, extensional regime.

This carbonate system was the subject of study for the doctoral thesis of Tomás, who presented a depositional model for this sedimentary succession based on sedimentological and architectural criteria, and studied in detail the coral assemblages and stromatolitic crusts preserved in these rocks (see Riding and Tomás, 2006; Tomás, 2007; Tomás et al., 2007, 2008). Recently, Moreno-Bedmar et al. (2009) have calibrated by means of ammonoids the lower part of the succession ascertaining the *Epicheloniceras martini* and *Parahoplites melchioris* ammonite biozones (Upper Aptian).

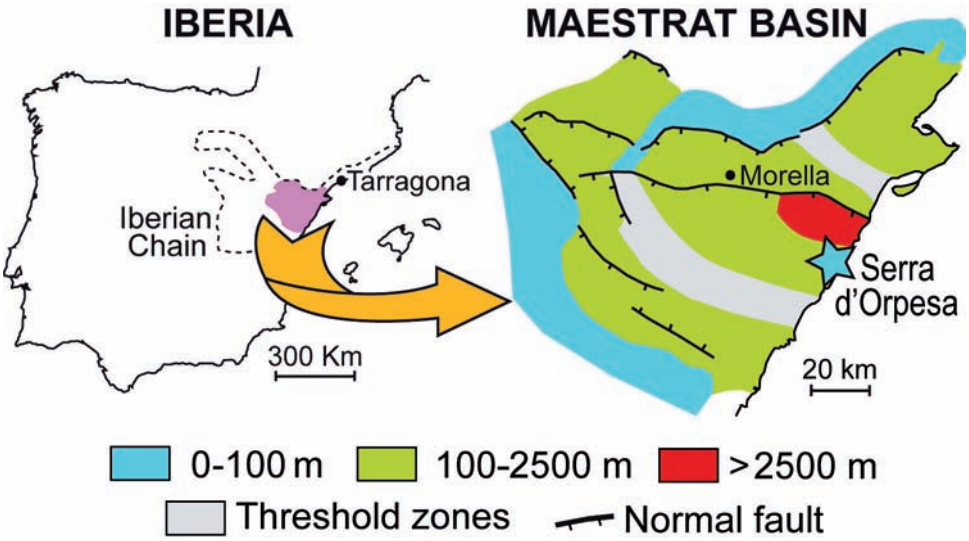

Figure 1. Schematic geographical maps with the situation of the Maestrat Basin in the eastern Iberian Chain (E Iberia), and the location of the Serra d'Orpesa within the south-eastern part of the Maestrat Basin.

On this background, the following study pretends to further investigate this Upper Aptian carbonate system providing an overview of the sedimentary succession and a sequence stratigraphic approach, serving as a basis for future refined investigations along these lines.

Materials and Methods

The present work is the result of a sedimentological, architectural and transgressive-regressive (T-R) sequence stratigraphic based analysis carried out along the Serra d'Orpesa. To this end, a synthetic stratigraphic log was measured, and the lithofacies changes, sedimentary features, clinoforms and key stratigraphic surfaces were mapped on panoramic photomosaics of the outcrops.

Results

The Upper Aptian sedimentary succession (Fig. 2) starts with basinal marls containing brachiopods, echinoids and ammonites. These marly deposits constitute the base of the Benassal Formation, which overlies the platform carbonates of the Villarroya de los Pinares Formation. In this part of the Maestrat Basin, the limit between these two formations was not recognized. However, in other areas of the Maestrat Basin this boundary corresponds to a composite surface (sequence boundary) with broad development of palaeokarst concealed by a hardground (Bover-Arnal et al., 2009). Hence, these marly sediments of the base of the Benassal Formation are construed to represent the transgressive systems tract (TST) of the first Upper Aptian sequence. The maximum flooding surface (MFS) of the sequence was placed at the top of this

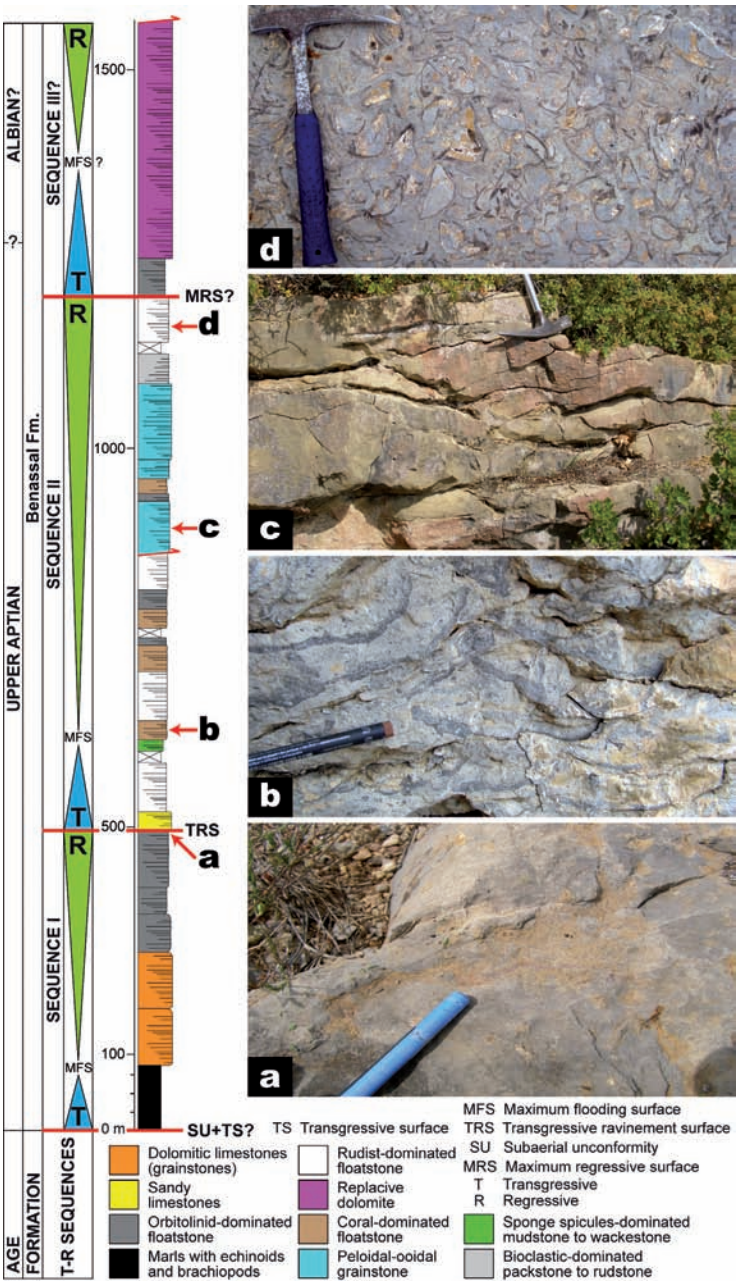

Figure 2. Schematic log of the Upper Aptian carbonate sedimentary succession showing the resulting transgressive-regressive (T-R) sequence stratigraphic approach. a) Close-view of the transgressive ravinement surface (TRS) showing a detail of a preserved palaeokarst infilling. b) Detail of a sheetstone growth fabric present in the regressive systems tract of T-R Sequence II. c) Detail of a bed displaying hummocky-cross stratification in the regressive deposits of Sequence II. d) Representative image of the rudist-dominated floatstone facies from the regressive systems tract (RST) of Sequence II.

basal marly unit. Above the marls, the regressive systems tract (RST) is characterized by dolomite cemented skeletal-peloidal grainstones with large-scale cross-bedding and platform carbonates with rudist bivalves, corals and abundant orbitolinids. The top of the sequence is distinguished by a transgressive ravinement surface (sequence boundary) displaying scarce preserved palaeokarst features (Fig. 2a).

Above this surface, sandy limestones exhibiting tidal bundles constitute the transgressive lag of the second T-R sequence. The rest of this systems tract is distinguished by limestones containing orbitolinids, sponge spicules and reworked rudist bivalves. The MFS of the sequence was placed at top of the beds with sponge spicules. The RST is characterized by rudist-dominated floatstones (Fig. 2d) and coral-bearing levels stacked in a prograding pattern, which displays downlap geometries. The coral-bearing levels show sheetstone (Fig. 2b) and platestone growth fabrics. These regressive carbonates alternate with three ocher colored sets of beds with hummocky cross stratification (Fig. 2c), which suggest middle to outer ramp storm-dominated episodes. Owing to the absence of surfaces showing subaerial exposure features, the upper boundary of this sequence is construed to correspond to a maximum regressive surface (MRS), which separates regressive rudist-dominated floatstones (below) from transgressive nodular-bedded limestones containing mud drapes (above).

The TST of the third sequence is mainly represented by limestones containing abundant orbitolinids. Above these levels, most of the sequence is replaced by medium- to coarse-grained ferroan dolomites with sucrose texture, forming a thick tabular dolomitized body within the host rock (Martín-Martín et al., 2009). The dolomitization process made impossible an age calibration of the original limestone and the recognition of the maximum flooding surface and the upper boundary of the sequence. In this respect, the possibility that the whole or part of this sequence could be Albian in age should not be ruled out.

The significant thickness displayed by the succession together with the presence of numerous fossilized syn-sedimentary faults suggests that syn-rift subsidence was the most important mechanism in creating accommodation space throughout the Upper Aptian in the south-eastern Maestrat Basin.

Conclusions

Three low-frequency T-R sequences bounded by a TRS and a MRS were identified along the Upper Aptian carbonate succession cropping out in the south-eastern Maestrat Basin.

Syn-rift subsidence was the most important mechanism in providing accommodation space as deduced from the considerable thickness of the sedimentary record (about 1500-m-thick) and the existence of fossilized syn-sedimentary faults.

References

Bover-Arnal, T., Salas, R., Moreno-Bedmar, J.A. and Bitzer, K., Sequence stratigraphy and architecture of a late Early-Middle Aptian carbonate platform succession from the western Maestrat Basin (Iberian Chain, Spain), Sedimentary Geology, 219, 280-231, 2009.

Martín-Martín, J.D., Gomez-Rivas, E., Travé, A., Salas, R. and Vergés, J., Fault-related dolomites in the Lower Cretaceous shallow marine succession of the Maestrat basin, NE Spain: Field evidence, Geophysical Research Abstracts v.11, EGU2009-12722.

Moreno-Bedmar, J.A., Company, M., Barragán, R., Salas, R., Martín-Martín, J.D., Bover-Arnal, T. and Gomez-Rivas, E., Precisiones, mediante ammonoideos, sobre la edad de la Fm. Benassal, Cuenca del Maestrat (Cadena Ibérica), *in* Palmpvist, P. & Pérez-Claros, J.A. (Coords.), Libro de Resúmenes de las XXV Jornadas de la Sociedad Española de Paleontología, Universidad de Málaga, 231-234, 2009.

Tomás, S., Sistemas arrecifales del Cretácico inferior de la Cuenca del Maestrat. Modelos deposicionales, paleontológicos y diagenéticos, PhD thesis, Universitat de Barcelona, 192 pp, 2007.

Tomás, S., Comas Nebot, M. and Salas, R., La plataforma carbonatada Aptiense superior de Benicàssim-Orpesa (Cuenca del Maestrat, Cadena Ibérica): modelo de depósito, Geogaceta, 41, 235-238, 2007.

Tomás, S., Löser, H. and Salas, R., Low-light and nutrient-rich coral assemblages in an Upper Aptian carbonate platform of the southern Maestrat Basin (Iberian Chain, eastern Spain), Cretaceous Research, 29, 509-534, 2008.

Riding, R. and Tomás, S., Stromatolite reef crusts, Early Cretaceous, Spain: bacterial origin of *in situ*-precipitated peloid microspar? Sedimentology, 53, 23-34, 2006.