Meaning of synsedimentary shortening tectonic structures along the Northern limb of the Aït Attab syncline (Central High Atlas, Morocco)

Significado de las estructuras tectónicas sínsemintarias contractivas a lo largo del flanco norte del sinclinal de Aït Attab (Alto Atlas Central, Marruecos)

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ABSTRACT

This work describes several structures located in the northern limb of the Aït Attab syncline, Central High Atlas, Morocco. The studied structures consist of E-W trending folds affecting the marine terms of the Bajocian, constituted by an alternate succession of marls and limestones and an angular unconformity of Bathonian sandy limestones above the Bajocian series. Taking into account recent works based on AMS and paleomagnetism, considering the presence of an early contractional episode during Bathonian time at Aït Attab or pre-Cenomanian at Imilchil area, we suggest that these folds can be explained as linked to fault or diapiric synsedimentary activity during extensional stage of basin borders, or as shortening structures in Bathonian series, although our structural analysis needs to be further refined.

Key-words: Synsedimentary deformations, Bajocian-Bathonian, Aït Attab syncline, High Atlas, Morocco.

RESUMEN

En este trabajo se describen varias estructuras geológicas observadas a lo largo del flanco norte del sinclinal de Aït Attab, Alto Atlas Central, Marruecos. Las estructuras estudiadas consisten en plegues de dirección aproximada E-W situados en la parte intermedia de la secuencia marina del Bajociense, constituida por una alternancia de calizas y margas, y una discordancia angular de calizas arenosas del Bathoniense sobre la anterior serie. Teniendo en cuenta los resultados obtenidos por nuevos trabajos utilizando datos de AMS y paleomagnetismo que muestran la presencia de un episodio de contracción temprana durante el bathoniense en Aït Attab o pre-Cenomaniense en la parte central de la cadena (zona de Imilchil), sugerimos de forma preliminar que los plegues que afectan a los materiales del Bajociense son el resultado de la actividad sinsemientaria de la fallas normales o del diapirismo en los bordes de estas cuencas, y los plegues que afectan a la serie Bathoniense están ligados a un evento de acortamiento durante el bathoniense.

Palabras clave: Deformaciones sinsemientarias, Bajociense Bathoniense, sinclinal de Aït Attab, Alto Atlas, Marruecos.

Introduction

The Aït Attab syncline, affecting Jurassic and Cretaceous rocks, is located at the northern border of the Central High Atlas of Morocco (Figs. 1 A and B). This intracontinental belt has been well studied, particularly regarding sedimentological, stratigraphic and magmatic aspects (Haddoumi, 1988; Laville and Piqué, 1991; Ibouh, 1995; Beauchamp et al., 1996; Gomez et al., 2000; Bensalah et al., 2013). Despite this evidence of a Jurassic-Cretaceous contractional and/or transpressional phase, the spectacular curved shape of this syncline and neighboring structures (Figs. 1 B and C) has attracted the attention of several geological studies. Recent works, based on AMS and paleomagnetism (Moussaid et al., 2015) have proposed that this curved shape is inherited from the Aït Attab basin geometry. These authors interpreted the E-W magnetic lineations in this area as the result of N-S convergent context, or linked to sinstral transpression occurred during the Jurassic and Cretaceous periods (Moussaid et al., 2013). Despite this, geological arguments and field data have failed to support this hypothesis. The objective of our research in this area of Aït Attab, is to look for structures and microstructures that can support this interpretation (Jurassic/Cretaceous folding). We have focused our field works on the northern limb of the Aït Attab syncline formed of Jurassic-Cretaceous red beds series, first because the series are complete.
and thick (Fig. 1D) and also, because the transition between the marine Jurassic series and the continental red beds presents significant tectonic structures.

Geological field data

Along the northern limb of the Aït Attab syncline, the Bajocien and Bathonian series (Haddoumi, 1988; Haddoumi et al., 2010) correspond to marls, marly limestones and sandstones. These series decrease in thickness gradually from west to east, along the northern limb of the syncline, and are considerably reduced at its southern limb (Haddoumi, 1988). Therefore there is a significant structural control on sedimentation mainly expressed by thickness changes.

In our field investigations along the northern limb of the Aït Attab syncline, we describe folded structures and unconformities in Aït El Jabri, Aït Abbas and Aït Bouguerrame sites. These structures can be interpreted as the result of synsedimentary tectonic events.

Site 1: In the village of Aït El Jabri, along the road Beni-Mellal to Aït Attab, we noted the presence of shortening synsedimentary structures at the base of Bathonian red clays (Fig. 2). They are NW verging reverse faults and E-W trending sealed folds. These structures are sealed by red clay levels showing variation in thickness (Fig. 2 B and C). These folds and faults are affected by the Cenozoic folding.

Site 2: North of the Aït Abbass town, we have described a succession of folds affecting the Bajocien limestones. Fold axes are oriented N076/20°W (Fig. 3).

Site 3: At Aït Bouguerram, the Bajocien limestones are folded and unconformably overlain by the Bathonian sandy limestones (Fig. 4). The Bathonian strata dip approximately 25°S, and show a progressive unconformity onto the Bajocien deposits dipping 50°S. This progressive unconformity is marked by a lenticular conglomeratic bed. On the other hand, the Bajocien calcareous series shows several metric to decametric folds and drag-folds, trending E-W, and parallel to the main axis of the Aït Attab syncline. These folded calcareous series are capped by the well marked "Rynconelles bar" (Rolley 1978) dated on the base of Brachiopods as Upper Bajocien (Haddoumi, 1988).

Discussion and conclusion

Tectonic structures observed along the northern limb of the Aït Attab syncline, corresponding to metric and decametric folds, trending E-W, and parallel to the main axis of the syncline, together with the unconformity between the marine Bajocien series and upper Bathonian red beds, militate in favor of a tectonic instability during this period. These structures have been associated with different tectonic settings (i) slumps related to Jurassic extension/transension widely demonstrated at the Atlas basins (Gratier, 1981; Laville and Piqué, 1991; Ilbouh, 1995), (ii) Jurassic-Cretaceous shortening deformation events (Moussaid et al., 2013, 2015) or recently, (iii) salt tectonics and gabbric intrusions associated with the main faults observed in Central High Atlas (Saura et al., 2014, Torres-Lopez et al., 2016). With the data presented in this work, we cannot distinguish their origin.
Fig. 2.- Photographs of some structures observed in the Bathonian deposits, Northern limb of the Aît Attab syncline. (A) Metric reverse fault, (B) Synsedimentary sealed folds, (C) Synsedimentary reverse fault, (D) Aspect of the main Cenozoic folding. Ver figura en color en la web.

Fig. 2.- Aspecto en campo de algunas estructuras observadas en los depósitos del Bathonense, en el flanco norte del sinclinal de Aît Attab. (A) fallas inercias de escala métrica, (B) pliegues sinsedimentarios fosilizados por capas superiores, (C) fallas inversas sinsedimentarias, (D) capas afectadas por el plegamiento principal cenozoico. See color figure in the web.

Fig. 3.- Geometry of folds observed at Aît Abbas site. Ver figura en color en la web.

Fig. 3.- Geometría de pliegues en Aît Abbas. See color figure in the web.
Within respect to the Lower Jurassic and Bajocian series, similar unconformities are widely found near main faults and have been considered as linked to diapiric activity, gabbroic emplacement or distortion related to synsedimentary normal fault reactivation (Laville and Piqué, 1991; Ibouh, 1995; Ettaki et al., 2007; Michaud et al., 2011). In our studied area, these deformations have been observed in the Bajocian series located close to basin boundaries without evidences of diapiric nor plutonic activities, and in this case, these structures can be related to an early N-S shortening deformation event.

However, sites studied in Bajocian red beds that are situated far from basin borders, display evidences of a contractional event that are consistent with N-S shortening also attested by the E-W trending magnetic lineation in primary magnetic fabric (Moussaid et al., 2013) and the pre-Cenomanian folding event dated by paleomagnetic data in the Aït Attab area (Moussaid et al., 2015). We can favor the presence of early shortening events, responsible for the change of sedimentation regime since Bajocian time. The general regression in the Atlas belt, and the abrupt change of sedimentation conditions from marine deposits to the continental red beds since Bajocian time, is probably accentuated by these early tectonic shortening phases.

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References


