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Review

Middle-Upper Triassic carbonate platforms in Minorca (Balearic islands): Implications for Western Tethys correlations

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ABSTRACT

In order to progress in the knowledge of the Middle to Upper Triassic evolution of the western Tethys realm, an integrated approach which includes new sedimentological, sequence stratigraphic and biostratigraphic data, has been accomplished in the carbonate marine successions (Muschelkalk facies) of that age in Minorca (Balearic Islands, Spain). The new biostratigraphy, which includes six successive ammonoid biozones, allowed to assign these carbonate successions to the uppermost Anisian–lower Carnian interval. The integration of the new chronostratigraphic framework with the sedimentological analysis allowed to recognize five main successive stages of carbonate platform evolution: 1) Initial marine transgression and shallow ramp development (uppermost Anisian); 2) Carbonate ramp drowning (Anisian–Ladinian boundary); 3) Prevalence of open sea conditions (Ladinian–early Carnian); 4) Abrupt sea-level drop (intra-lower Carnian) and; 5) Shallow carbonate ramp and transition to sabkha systems (Keuper facies). Furthermore, the sequence stratigraphic analysis allowed to divide some of these stages into depositional sequences.

Minorca was located in the westernmost Tethys area during the Triassic, in a key paleogeographic location close to the present-day Iberia, Sardinia and the Cottian and Southern Alps. The new data have allowed an interregional comparative analysis among these areas, with recognition of major suprarregional events and episodes in the framework of the western Tethys evolution.

1. Introduction

The Middle Triassic was characterized by widespread development of carbonate platforms in the western part of Europe (e.g., Ziegler, 1990). The progressive break-up of Pangea, initiated during the Late Carboniferous–Early Permian times, and the consequent opening of the Tethys Ocean caused the generation and controlled the evolution of a net of linked, rapidly subsiding, rift basins related to ancient sutures (e.g., Gutiérrez-Alonso et al., 2008; Muttoni et al., 2009). The basins, which characterized the so-called western peri-Tethyan domain, accumulated thick sedimentary series of continental "red-beds" of late Paleozoic to early Mesozoic age (e.g., Bourquin et al., 2011). These continental environments, mainly alluvial to fluvial systems, prevailed during more than 40 m.y. until the generalized arrival of marine waters took place causing their demise. During the Middle Triassic this long-term, large-scale transgressive process culminated with the rapid landward retreat of the continental systems in those basins and the rapid development of vast carbonate platforms.

The transgressive process was anisochronous and strongly controlled by the previous topography and geography, as well as by the synsedimentary rifting tectonics, still active in many basins (Ziegler and Stampfli, 2001; Stampfli and Kozur, 2006; Schettino and Turco, 2009; Franz et al., 2013). Also, a major tectono-eustatic sea-level rise accompanied the whole episode (e.g., Haq et al, 1987; Hallam, 1992; Gianolla and Jacquin, 1998). Despite the widespread character of the Middle Triassic transgressive episode in the Western Tethys, there is still very few information about its precise timing as well as of its evolutionary patterns. In fact, some previous tentative essays of correlations have been presented among the different basins of this area (e.g. Budurov et al., 1993; Cassinis et al., 2003, 2007; Bourquin et al., 2007, 2011) and also between the internal basins of Iberia (Sopeña et al., 1988; López-Gómez et al., 1998; Sopeña and Sánchez-Moya, 2004), but most of them based still on weak chronostratigraphic data. Such lack of precise interbasinal correlations is due in part to the scarcity of modern regional studies on those carbonate platforms in Iberia and other basins, but mainly because the difficulties of obtaining accurate data from the sedimentary successions. In fact, the studies of those platforms have been frequently hampered by: 1) the pervasive dolomitization shown by many successions which strongly limits the recognition of original facies and paleontological assemblages, and 2) the

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important provincialism shown by most groups of marine fossil including those frequently used in biostratigraphic studies, such as ammonoids. So, the best studied sections show a very local character.

In order to progress in the knowledge of the Anisian to Carnian evolution of the western part of the Tethys realm, an integrated characterization of the carbonate platforms of that age outcropping in the Island of Minorca (Balearic Islands, Spain) has been accomplished, based in new sedimentological, biostratigraphical and sequence stratigraphical data obtained from intensive field work. The island was chosen because 1) it contains excellent outcrops of these Triassic platforms, only partially dolomitized, which have received very scarce attention since the pioneer regional works of the 1970's (e.g., Bourrouilh, 1973); and 2) the potential of its platforms for improving the knowledge of the Western Tethys during the Middle–Upper Triassic, mainly because its key position for interbasinal correlations between Iberia and other Mediterranean and European areas.

2. Geological setting

2.1. Tectonic framework

Minorca is the easternmost of the Balearic Islands, which are the emerged part of a raised platform called the Balearic Promontory, located in the Western Mediterranean and surrounded by the Valencia Though, the Algerian Basin and the Ligurian Basin (Fig. 1A). The former of these ones consists of thinned continental crust (e.g., Bartrina et al., 1992; Watts and Torné, 1992) whereas the other two are floored by Tertiary oceanic crust (e.g., Séranne, 1999; Rosenbaum et al., 2002). All these basins which isolate the Balearic Promontory were generated during the Late Oligocene and the Early Miocene in response to extensional tectonics in back-arc basins. In fact, the present configuration of the Balearic Promontory derived from a complex geological history. In the first works for the reconstruction of the

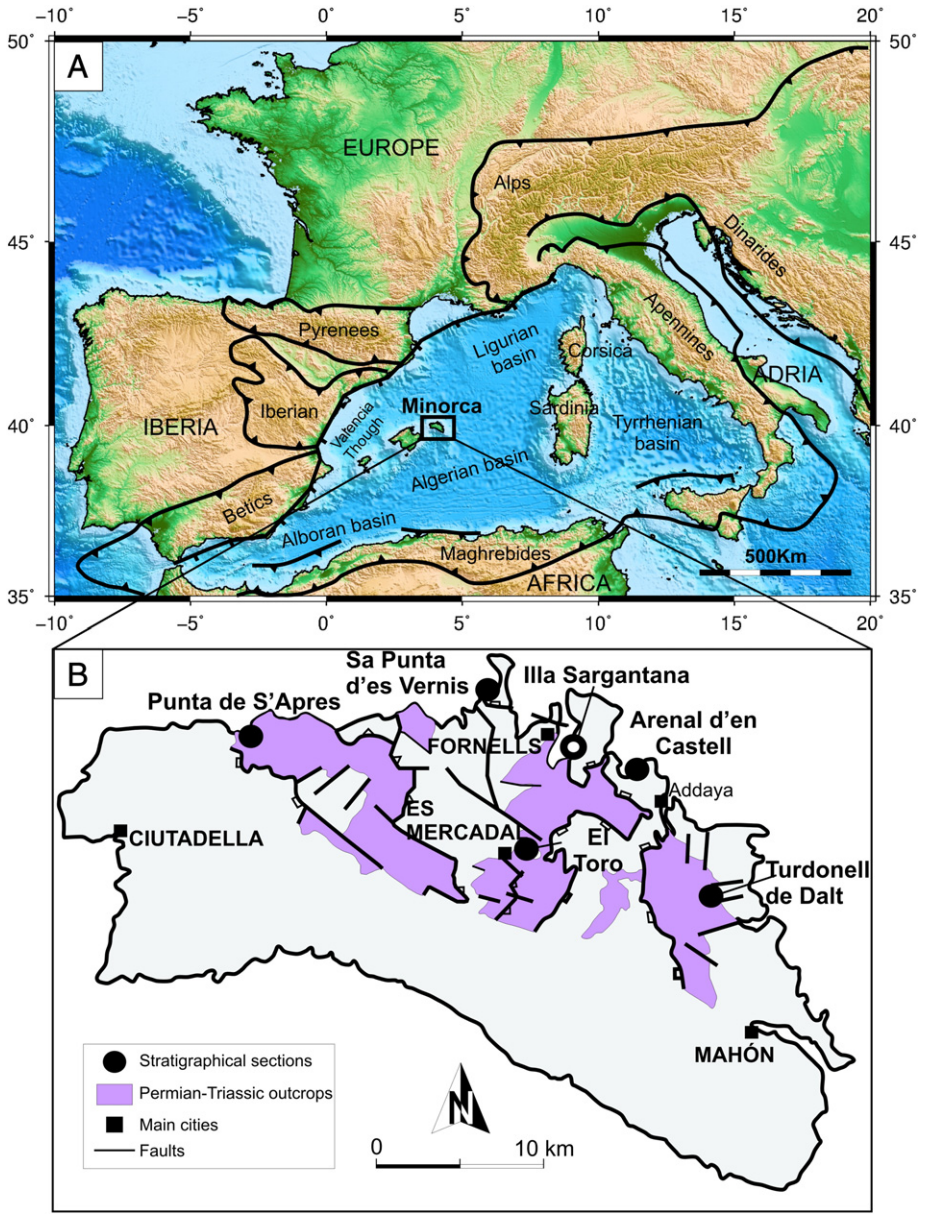

Fig. 1. A) Simplified geodynamic setting of the Western Mediterranean region (modified from Carminati et al., 2012). Black rectangle marks the study area. B) Permo–Triassic outcrops in the Minorca Island, with the geographical location of the studied sections.