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Middle Triassic carbonate platforms in eastern Iberia: Evolution of their fauna and palaeogeographic significance in the western Tethys

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ABSTRACT

This article reports the first integrated study of the Middle Triassic of Iberia, based on the stratigraphy, sedimentology, and fossil fauna of Muschelkalk facies of the Iberian Ranges and the Catalan Coastal Ranges in Spain. On the basis of this study, new palaeogeographic reconstructions of the westernmost Tethys are proposed, and the evolution of the different palaeogeographic domains of Iberia (e.g., Iberian, Mediterranean, and Levantine–Balearic) are described.

In these domains, Muschelkalk facies record the development of wide carbonate platforms that were the consequence of the first two broad marine transgressions of the Mesozoic in Iberia, respectively, late Pelsonian–early Illyrian and late Illyrian–Longobardian. Of these marine incursions, the oldest only manifested in the Mediterranean Triassic domain (Catalan Coastal Ranges and part of the Iberian Ranges), which acted as a palaeogeographic gulf opening northwards. Most of the fauna related to this first incursion show strong affinities with the Alpine/Germanic bioprovinces, related to the Palaeotethys. In contrast, the second transgressive episode took place in a new regional palaeogeographic setting related to the intra-Pangea dextral shear, and the northward movement of the Cimmerian microcontinent. A rapid sea-level rise induced generalised marine flooding of the Iberian, Mediterranean, and Levantine–Balearic Triassic domains. The resulting carbonate platforms yield fossil assemblages (ammonoids, bivalves, foraminifera and conodonts) that show affinities with those of both the Alpine and Sephardic bioprovinces related to the Neotethys. These assemblages point to a significant increase in diversity during the late Fassanian–Longobardian, possibly related to the prevailing wider connections between the sea corridors, an increased continental run-off and input of nutrients and/or a general cooling of marine waters.

1. Introduction

The Middle Triassic was an exceptional time period during which, after the end-Permian mass extinction, several global factors determined an acceleration in the recovery of the biota and extensive radiation (Erwin, 1996). This key process in the evolution of life, which ended with the replacement of the "Palaeozoic Fauna" with the "Modern Fauna" (Sepkopski, 1984; Márquez-Aliaga, 2010; Ros et al., 2011), was triggered by the progressive stabilisation of the carbon cycle, which had been punctuated during the Early Triassic by multiple periods of massive CO_2 release (Payne and Kump, 2007). This strong instability in the carbon cycle and the associated volcanic input of sulphurous gasses, provoked huge environmental perturbations in both the atmosphere and the oceans (Márquez-Aliaga et al., 2003; Kidder and Worsley, 2004; Márquez, 2005; Plasencia and Márquez-Aliaga, 2005; Woods, 2005; Tong et al., 2007; Sun et al., 2012) and hampered biotic recovery in immature and poorly functioning marine ecosystems throughout the Early Triassic. The delay in recovery lasted about 5–10 m.y. (Lehrmann et al., 2006; Pruss et al., 2006; Algeo et al., 2011), though some groups such as ceratitids and ammonoids, possibly recovered faster than was previously estimated (Brayard et al., 2009).

At the time of environmental stabilisation, the western Tethys realm experienced a broad marine transgression from the East, controlled by the break-up of Pangaea. That marine invasion took millions of years to reach its westernmost boundary in Iberia. This occurred in the Middle Anisian (López-Gómez et al., 1998), when shallow marine waters

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determined the deposition of shallow marine carbonate units (Muschelkalk facies). Such marine carbonate deposition prevailed until the end of the Ladinian (or onset of the Carnian), when a prolonged regressive episode allowed for the deposition of the Keuper facies (López-Gómez et al., 2002).

The present integrated study of the Middle Triassic carbonate ramps of E Iberia (Iberian Ranges and Catalan Coastal Ranges) (Fig. 1) based on stratigraphic, sedimentologic, and palaeontologic data sets, proposes a new stratigraphic framework that differs substantially from existing palaeogeographic reconstructions of the westernmost Tethys for the Middle Triassic. Marine fossil assemblages (ammonoids, bivalves, foraminifera and conodonts) were examined in terms of biogeographic affinities and changes in palaeodiversity. The results reported here should provide new insight into how life recovered in the shallow waters of the Tethys after the Permian mass extinction.

2. Geological and geographical framework

The evolution of the Triassic grabens systems of Western and Central Europe was related to the southward propagation of the Norwegian-Greenland rift system and coeval with the development of the Tethys rift system (Ziegler, 1990), which took place during fragmentation of the Pangaea supercontinent. In this period of crustal extension, four major rift basins developed in the northern, northeastern and eastern portions of Iberia (Pyrenean, Ebro, Catalan and Iberian Basins), primarily through reactivation of older Variscan faults.

The Iberian and Catalan Basins developed primarily during the Mesozoic, when they experienced several extensional periods (Arche and López-Gómez, 1996; De Vicente et al., 2009). The first of these periods (Late Permian–Late Jurassic) occurred in two main stages: a first episode or rifting stage with at least three synrift–postrift pulses characterised by

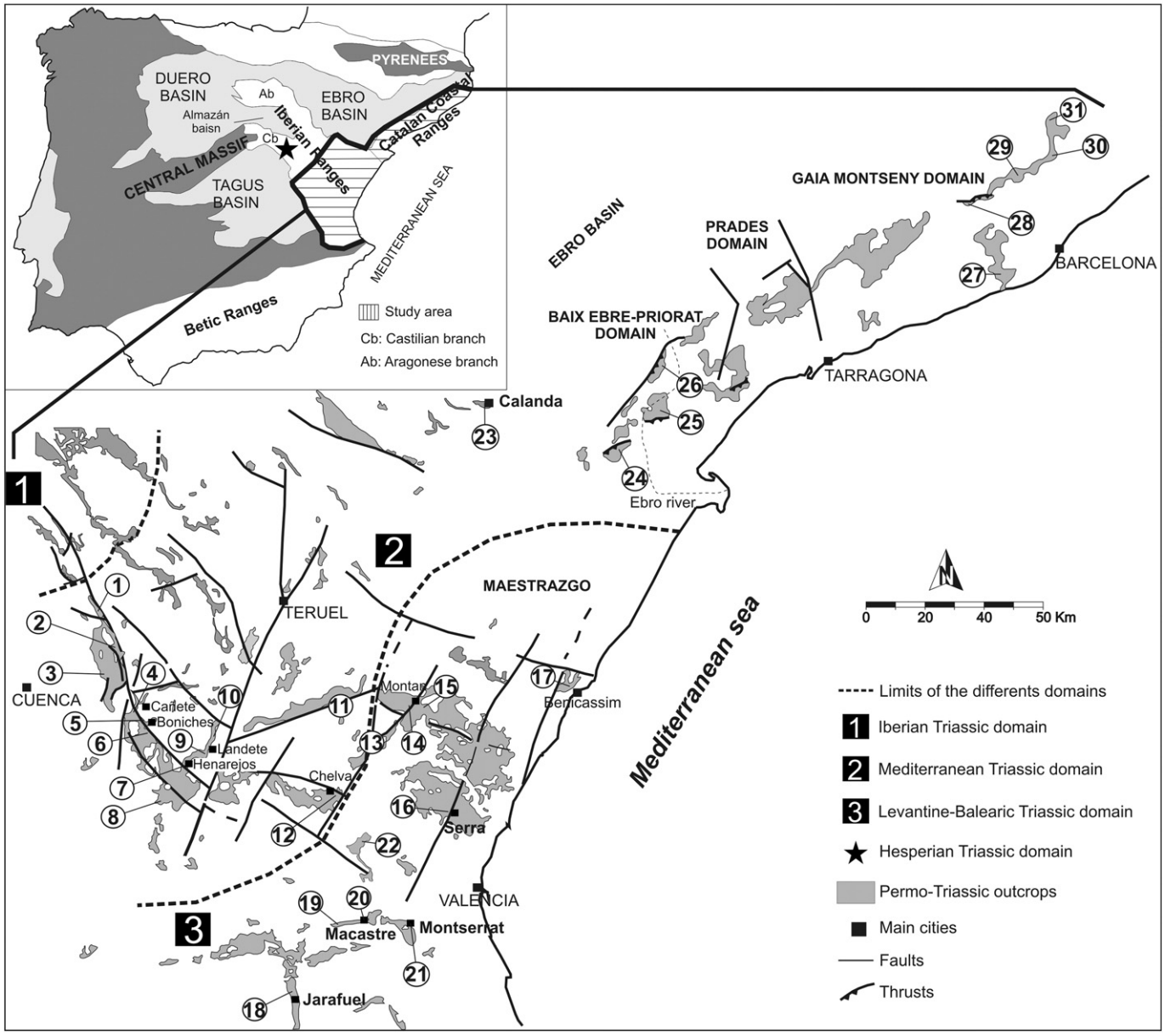

Fig. 1. Permian–Triassic outcrops in the Iberian Ranges and Catalan Coastal Ranges. Indicated are the geographical locations of the main fossiliferous sections and palaeontological sites of the Muschelkalk facies. Stratigraphic sections of the Iberian Ranges: 1. Huélamo; 2. Valdemeca; 3. Camarena; 4. Barranco de la Hoya; 5. Cerro Morrón; 6. Boniches; 7. Henarejos; 8. Villora; 9. La Ermita; 10. Moya; 11. El Paraíso; 12. Chelva; 13. El Molinar; 14. Cueva Cirat; 15. El Tormo; 16. Serra; 17. Agujas de Santa Águeda; 18. Jarafuel; 19. Mijares; 20. Macastre; 21. Montserrat; 22. Bugarra; 23. Calanda. Main palaeontological sites of the Catalan Coastal Ranges: 24. Alfara; 25. Benifallet; 26. Camposines; 27. Begues; 28. Olesa; 29. El Farrel, 30. Centelles and 31. L'Ametlla.